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The SCIENCE COUNSELOR

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The Science Counselor

"FOR BETTER SCIENCE TEACHING"

A QUARTERLY JOURNAL *of teaching methods and scientific information especially for teachers of science in Catholic schools. Published at Duquesne University, Pittsburgh, Pennsylvania, in March, June, September and December by*

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CONTENTS

YOU MUST DECIDE

¶ On the next page you will find an important article dealing with the future of THE SCIENCE COUNSELOR.

¶ It is essential that you read it carefully to the end.

¶ Please do so. Then help if you can.

To the Catholic Schools of America:

Here is a problem for your consideration.

It is a serious one.

If you will, you can solve it now, quickly. Tomorrow will be too late.

***This is the problem:* Shall *The Science Counselor* cease publication for lack of financial support from its readers when a minimum of 500 new subscriptions will save it? Must this journal be a war casualty? Or is it worth saving?**

You have been receiving *The Science Counselor* for the past eight years, many of you, free. Is it a creditable publication? Is it needed? Has it brought prestige to Catholic science education? Have you found it interesting and helpful? Has it tried to keep you in touch with new trends in science teaching? Has it brought you authoritative information about the latest developments in many special fields? In it have you found useful helps for teachers and administrators? Has it given you assistance in selecting textbooks, in improving your library, in conducting school clubs and other extracurricular affairs? Has its yearly science essay contest stimulated the interest and the scholarship of your pupils?

Some of the country's most eminent scientists and educators have been glad to contribute articles to *The Science Counselor*. But it has encouraged little known writers as well. We have been proud to present the first publications of many worthy but modest teachers. Catholic religious teachers have found it a suitable medium for the expression of their views. It is a journal especially for them; much of it has been written by them.

How has THE SCIENCE COUNSELOR been received by scientists and educators in general?

With enthusiasm, judging by letters to the Editor and by other expressions of appreciation.

Have you not seen its book reviews used for sales promotion? Did you read the full page advertisement featuring a *Science Counselor* book review that has appeared several times in the *Journal of Chemical Education?* Have you not found this journal mentioned frequently in lists of journals helpful to teachers of science? Have you noticed the growing number of abstracts of its articles that appear in important journals of science and education? Do you know that teachers' colleges use it in their "methods" courses? Did you find two of its articles reproduced in *The Catholic Digest?* Are you aware that for some time *Science Counselor* articles have been regularly abstracted in *Chemical Abstracts* and *Biological Abstracts*, a very high honor indeed?

You should know that this journal has won readers in Canada, in Puerto Rico, in our island possessions, in Great Britain, Ireland, and Continental Europe, in Egypt and other parts of Africa, in India and in China. A non-Catholic educator was so impressed by this journal, which he encountered while studying for the doctorate at Stanford University, that on his return home to Australia he took special pains to call it to the attention of Catholic educators there. Public libraries in our greatest cities bind *The Science Counselor*. So do universities and colleges. Recently city and college libraries have purchased back numbers, in some cases full sets, to make their files complete and up-to-date.

We would not bring these facts to your attention if we did not feel that you should know them because the situation is so critical. We believe that THE SCIENCE COUNSELOR is too valuable a publication, too important an asset to Catholic education, to be allowed to die. But no journal is worth saving if its readers do not value it enough to support it financially. The sum necessary to keep it alive is not large, especially when divided among many.

The Science Counselor is produced economically. No person connected with its staff either receives or expects compensation for his work. Contributors have been paid only in thanks and appreciation—ours and yours—not in money. Advertisers have been generous in their patronage. Some of them have used space in every issue since the start. Many of our subscribers have been just as faithful. Some have been scrupulous in paying the subscription fee yearly. Others have sent in subscriptions covering a five-year, and in one case a ten year, period. Recently, one Sister sent a check to cover 17 separate subscriptions.

But above all others, Duquesne University has been generous. For eight years it has absorbed without complaint the considerable yearly deficit, hoping always that eventually the journal's many readers would rally to its support. The University founded *The Science Counselor* and has carried it on as a "good work." Every Catholic high school and college in the United States in which science is taught was put on its mailing list. The University has never regretted this action. Neither does it now complain. Many schools to which this journal has come regularly did not ask for it. But if it has benefited them over the years, they might well feel that it is only right that some return should now be made. Like all other schools, Duquesne University finds it necessary to watch ex-

(Continued on Page Thirty-six)

Supervision in Secondary-School Science

● By Franklin T. Mathewson, Ph.D., *(New York University)*
SCIENCE DEPARTMENT, SENIOR HIGH SCHOOL, WHITE PLAINS, N. Y.

Every one knows that good supervision makes for good science teaching. What about "snoopervision?" Dictation? Checking up? Interference?

Dr. Mathewson, who has recently conducted an extensive and important study of certain phases of science instruction in secondary schools, here reports some of the conclusions he reached as a result of his research.

Most teachers and all supervisors should agree that the most important function of a supervisor is to stimulate, encourage and assist teachers to improve themselves.

Read the concluding paragraphs with especial attention. They will furnish food for thought.

●

Supervision is an important factor in the in-service education of science teachers, ranking ninth in importance as shown in recent research[1] by the writer. A brief summary of the research technique employed and the general conclusions reached may be found in *Science Education.*[2] The study shows supervision to be far from attaining its possibilities. Apparently much more consideration should be given to this educational device.

I would like to discuss the problem from three angles: (1) agencies of supervision; (2) fields in which supervision is needed; (3) methods of supervision, giving most consideration to the second item.

Agencies of Supervision

In considering supervision, such general problems of teaching as maintaining attention, discipline, and guidance work were ruled out. This must be kept in mind when considering the following data.

The most important agency of supervision for the particular needs of science teachers, according to this study, is clearly:

A. The secondary-school science department head.
B. The city or special science supervisor, where his services are available.

If the school is too small to warrant a department head with time allotted for supervisory duties, and if a city or town is not large enough to justify a science supervisor, then other agencies become the "most important," *i. e.*

C. The "follow-up" service of teacher-training institutions, for new teachers with little or no experience.
D. Self-supervision and self-rating sheets for general value in most situations. The latter would rate higher for the small rural schools.
E. Where the services of teacher-training institutions in co-operation with local administrators are available, they may have great usefulness.
F. Next in value as shown by this study are the principal and superintendent of schools. The latter agency would rate higher than sixth for many needs, but also much lower for others in the science field.

Of much less value are the agencies of

G. Critic or itinerant teachers.
H. State supervisors of science.

Critic or itinerant teachers would be of greater value in rural areas, and the state supervisor of science, while not so tangible in his services to individual teachers, may make this up by serving a large number of teachers. State supervisors of science, and to a lesser extent the city supervisors of science, come the furthest from achieving their possibilities.

It is expected that a more complete analysis of the relative value of various agencies for the supervision of science will appear soon in *Educational Administration and Supervision.* Therefore elaboration of these results will not be undertaken here.

In view of the importance of department heads and city supervisors of science it is most unfortunate that the economic situation since 1929 has resulted in the tendency of many school systems not to appoint or replace them. Because of the importance of these agencies, it is recommended that part-time supervisors be much more commonly appointed in school systems having more than one secondary-school building. Part-time supervision is recommended rather than full-time since some actual personal contact with the classroom situation seems advisable for supervisors. This is not to be interpreted as meaning that most of the supervisor's time is to be taken up with teaching. A possible solution for department heads is the rotation of the position among the more able members, giving each a three to five year term. This might not involve an increase in salary but should certainly give the department head less of a teaching load. Such a plan implies serving rather than bossing the other members, injects new blood, and discounts pure seniority.

Fields in Which Supervision is Needed

Supervisors should assist secondary-school science teachers chiefly in the fields listed below, arranged approximately in their order of importance, by:

[1] Franklin T. Mathewson. *A Study of the Contributions of Certain Professional Activities to the In-Service Education of Science Teachers in Secondary Schools.* Doctor's Thesis (unpublished) New York University, 1941. pp. 449.

[2] An Evaluation of In-Service Education Devices for Meeting Specific Needs of Science Teachers in Secondary Schools. *Science Education,* XXVI (February, 1942). pp. 78-82.

A. Encouraging, stimulating, and assisting teachers to improve themselves.

B. Co-ordinating the activities of science teachers.
   1. In the same subjects.
   2. In the science sequence.
   3. With non-science subject teachers.

C. Ascertaining the science needs of the pupils in the community.

D. Assisting to organize the content and methods of science to achieve the aims and objectives. This apparently involves:
   1. The development and popularization of a better philosophy of science education considering its relation to general education.
   2. Evaluation in terms of objectives, testing other than just memorized factual materials.
   3. A curriculum which is functional to the needs of pupils;
      a. providing practical applications, promoting human adjustments
      b. emphasizing personal and social implications of scientific principles and discoveries
      c. developing ability in problem solving and the use of the scientific method
      d. providing for a science sequence extending from grades 1 to 12 or 14.
   4. Methods of proven practical value which arouse and hold the interests of pupils, motivating their work;*
      a. providing for diversified and increased pupil activity
      b. based on sound psychology of learning (and teaching) as well as adolescent psychology.

E. Promotion of a warm-hearted, sympathetic personality in teachers and encouragement of a broad, general, cultural background beyond sciences.

F. Teacher acquisition of specialized science content material, including:
   1. Latest developments in fields of scientific research
   2. Laboratory and demonstration techniques
   3. The integration of specialized courses to meet secondary-school needs
   4. New and striking demonstrations
   5. Use of new research apparatus.

G. Improvement of teaching conditions, including:
   1. Suitable teaching loads
   2. Better laboratory facilities and equipment
   3. New materials

H. Assistance with other curricular trends not mentioned in conclusion "D-3" such as:
   1. Visual aids
   2. Conservation education
   3. Consumer education
   4. Pupil determination and solution of their own problems involving science in science classes
   5. Non-college-preparatory secondary science courses
   6. Health education
   7. Less emphasis on facts as an end in themselves
   8. Sex education
   9. Vocational science courses
   10. Integrated, fused, and survey science courses.

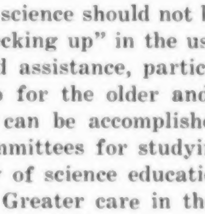
I. Assistance with specific methods not mentioned in conclusion "D-4", including:
   1. Developing understanding of scientific principles and generalizations
   2. Organizing and conducting science clubs
   3. Organizing and conducting museum, industrial, and nature field trips
   4. Using supplemental reading as a co-ordinated part of the teaching process
   5. Using radio and recordings
   6. Use and evaluation of workbooks or notebooks
   7. Coping with students of low mental ability.

It should be pointed out that this study was concluded before December 7, 1941. In view of this the above list should probably be modified to meet wartime needs. New needs would probably fit in under the above headings. The science teacher is still faced with new curricular trends, organization of materials, and self-improvement.

Methods of Supervision

Supervision in science should not be "snooper-vision," dictation, or "checking up" in the usual sense. It must be leadership and assistance, particularly when asked, and especially so for the older and more experienced teachers. Much can be accomplished through the organization of committees for studying the new aspects of the philosophy of science education, the curriculum, and evaluation. Greater care in the selection and appointment of teachers should avoid the necessity for "forceful" supervision. There is considerable evidence to show that so long as there is no trouble in discipline, promotion, or "passing" of students, most teachers never experience anything that could be called supervision. In many cases the supervision that is experienced is dictatorial and considered by the classroom teacher to be "interference." From the point of view of the supervisor many teachers need more than "gentle encouragement" to "get them out of the rut" and put them "on their toes."

With the present scarcity of experienced science teachers and the many changes to new work by teachers with inadequate preparation, the helpful, encouraging science supervisor or department head is probably needed more than ever before—but he must be relieved of some teaching to do the work. ●



* The supervisor should do more than bring these methods to the attention of teachers—he should co-operatively assist them in developing these skills and techniques.

Pre-18 Aviation Education

• By Robert W. Hambrook

SENIOR SPECIALIST, TRADE AND INDUSTRIAL EDUCATION, U. S. OFFICE OF EDUCATION, WASHINGTON, D. C.

This important article discusses a topic of much current interest. Based on long experience in aviation-education matters, it represents America's best thought on the question.

The writer, who has studied the English situation at first hand, presents some interesting ideas about the physical and mental fitness of the students, the subjects to be stressed, suitable textbooks, and textbook material. He discusses the aviation courses now in operation in the District of Columbia high schools and outlines their general and emergency aims.

●

It was my privilege in the Spring of 1941 to visit eight Royal Air Force Training Stations, a Bomber Station, and a Fighter Station in England. At all these places where I came in contact with all types of Royal Air Force personnel, I was much impressed by their youthfulness. I stayed at the fighter station until after midnight and saw pilots take off and return from combat flights. I was at the bomber station at 9 o'clock, 11 o'clock, and 3 in the morning; I heard the pilots and crew members briefed, saw them leave, and heard their stories when they returned. They showed evidence on returning from their hazardous duties of the tremendous strain under which they had been.

The Air Training Corps of England

A month or so later I was introduced to the Commandant of the Air Training Corps, Air Commodore J. A. Chamier, and heard him tell of the origin of the Air Training Corps and its unique record of enrollment of 100,000 English boys between 16 and 18 years of age in the brief period of one month. Following this I was taken to see an Air Training Corps group in action, with headquarters at one of the large aircraft factories and the Commanding Officer an important official of the company.

It was indeed interesting to watch these boys drilling on the factory grounds to their own band, and to see them in the office building, in the cafeteria and dining rooms, being interviewed for enrollment, examined for physical and mental fitness, and receiving instruction in such subjects as Theory of Flight, Airplane Construction, Aircraft Engine Operation, Morse International Code, Radio Principles, and numbers of other subjects pertinent to the war.

The British were finding difficulty at that time in securing flight personnel for the future. It is obvious that young men of the best physique and high mental standards are essential to the operation of military aircraft. Consequently, the British decided on having prior choice of the youth of the country before reaching their 18th year, and previous to being called up. Young men of lesser qualifications, both physical and mental, can serve satisfactorily in many other war efforts. Therefore, an early selection of youth fitted for aviation was essential.

The U. S. Needs Pilot Crews

Likewise, the United States is finding it necessary to plan ahead in order to be assured of adequate flight personnel for future service if the war continues. A few months ago it was indicated that there would be a need for 100,000 air cadet trainees in addition to those already in the Air Services. The Army needs pilots, bombardiers, and navigators, while the Navy needs pilots. It is understood that the ratio of needs for flying personnel ranks as follows:

Pilots - - - -	5
Bombardiers - -	1
Navigators - -	1

Physical Fitness

Physical fitness is naturally the first fundamental requirement to be met. The following standards are set for aviation cadets in the U. S. Army Air Services:

- Visual acuity 20/20 bilateral
- Normal color vision
- Unimpaired ocular muscle balance
- Unimpaired optical organism, anatomically and mechanically
- Good respiratory ventilation and vital capacity
- Hearing 20/20 each ear
- A stable equilibrium
- A sound cardiovascular system, nervous and organic
- A well-formed, well-adjusted, and coordinated physique
- Height, minimum 60 inches, maximum 76 inches
- An integrated and stable central nervous system
- A minimum of 12 teeth, 3 pairs each of serviceable, natural, opposing incisors and masticating teeth.

The following standards are set for the Navy:

- Normal vision 20/20 each eye, unaided by glasses
- Normal hearing
- Normal color vision
- Minimum height requirement 64 inches, maximum height requirement 76 inches
- Minimum weight requirement 124 pounds, maximum weight requirement 200 pounds
- Minimum blood pressure, systolic 105, maximum systolic 135
- No history of asthma or hay fever

Freedom from rupture or evidence of abnormal relaxed rings, conducive to rupture

Minimum of 18 sound teeth, 2 of which shall be opposing molars.

Mental Standards

There are certain "screening tests" which are used both by the Army and Navy to indicate mental qualifications for pilot duties. However, young men who have shown aptitude in mathematics and physics are likely to meet the basic requirements for mental qualifications. Both the Army and Navy Air Forces have prescribed contents of courses of study for meeting the physics and mathematics tests required of those wishing to enter the Air Services.

Aviation Emphasis for High Schools

The 28,000 public and private secondary schools of the United States are being requested to modify their regular programs sufficiently to put emphasis on such subjects as those covered by the Air Training Corps of England. Time is an important element in this war and, consequently, the mastering of basic aviation and other subjects saves the time required to deal with these topics after entrance into the Air Services. The change of emphasis will not be such sacrifice as may be supposed by some, but will liven the courses of study in high school to a considerable extent. One of the ATC boys, speaking over the British Broadcasting Company a few nights ago, when interrogated about the subjects taught in school and the same subjects taught in the ATC, said that in the ATC the subjects were motivated in the training and that he even liked mathematics because he knew the reason he had to learn it. It is anticipated the additional attention given to mathematics and physics alone will be of definite benefit to the high school curriculum.

Physical Fitness Courses

However, not only is it being requested that mathematics and physics be stressed, especially in the last year or so of high school, but that considerable attention be given to physical fitness on the basis of what has been revealed on the general physical condition of young men called up in the Selective Service System. This also will bring stress to a neglected matter.

Aviation Subjects to be Stressed

Mathematics, physics and physical fitness need not necessarily circumscribe the work of the secondary school in the emergency. There are other subjects which can contribute in a great measure in the war effort, especially in aviation. Any subject required by aviation cadets which can be given before the cadet enters the Air Services decreases the time required to make him fit for active duty. It is possible to give instruction in aerodynamics, aircraft structures, types of military aircraft, recognition of aircraft, principles of aircraft engines, types of power plants, elements of meteorology, air navigation, communications, etc. I hope the subject of the history of aviation will be left to those who are taking general aviation, as this subject has great fascination for some people, and contributes little to the flyer, except as a matter of interest.

Technical Textbooks

There was a time, perhaps ten years ago, when it was very difficult to find suitable textbooks on aviation, especially for vocational training purposes. Most of the books which could be used for text material were quite general, and dealt with a wide range of subject matter, all of which could not be of vocational value except to a limited few. In the last few years, however, the trend has been in the direction of definiteness, and, consequently, there is now a wide range of textbooks dealing with aircraft sheet metal work, riveting, aircraft maintenance, propellers, aircraft power plants, and many other specific aircraft components.

High School Text Material

Publishers, too, within the past year or so have seen the demand increase rapidly for books dealing with aviation subjects in a more general way. Thus, there have been developed numbers of texts dealing with aviation theory and practice for the high school student level. These books set forth the theory of flight, the principles of the internal combustion engine, the materials and construction of aircraft, types of aircraft and aircraft engines, the fundamentals of meteorology and air navigation—all subjects essential to the future flyer.

There are those who will dispute the principle, but I believe that we, like England, should avoid as much as possible disrupting the school program of those who will not be called on to participate in the actual war efforts. I am sure that we do not want any boy or girl to be able to say that during this war regular education was not functioning and that he or she was deprived of the American educational heritage. On the other hand, it is undoubtedly true that the inclusion of aviation in the curriculum can be a means of enriching the school program.

District of Columbia Aviation Courses

In the District of Columbia, by Congressional action, aviation has taken its place among the courses for which credit toward graduation is given. The courses were first available last February and proved so successful, with three teachers devoting full time to the work and an enrollment of 286 boys, that the work has expanded considerably, taking in additional teachers and students. Although the authorizing legislation for the course was drafted before the emergency, and the program planned to provide only a general background in aviation, the greater part of those enrolled, who were mostly seniors, are now either pursuing the subject further professionally, continuing in school, or are already in the Air Forces.

(Continued on Page Thirty)

The Pilot and Meteorology

● **By Frederick L. Caudle**
ASSISTANT PROFESSOR AND COORDINATOR, C.A.A. WAR TRAINING SERVICE,
UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN.

Mark Twain's famous statement about the weather is no longer strictly true. We are not able to change it, but we are doing something about it.

Here a skilled weather man tells how important a knowledge of the weather is to the aviator. The information he gives will be of value to the teachers who are now either studying or teaching meteorology.

Mr. Caudle is co-author of the Finch, Trewartha, Shearer and Caudle "Elementary Meteorology" which has been adopted by many high schools and which is reviewed in another place in this number.

●

Meteorology, the science of the atmosphere, has long been a part of the study of physics in high schools and colleges. This is a logical arrangement since meteorology is the physics of the earth's atmosphere.

Climate, on the other hand, is a study of generalized or average weather conditions, and has always been studied in geography. This is appropriate because climate has so much to do with the earth, its peoples and its resources.

The study of meteorology affords boys and girls alike an understanding of weather, which is so important in the fields of agriculture, commerce, industry, aviation, and in our every-day lives. It also offers meaningful and interesting applications of mathematics and science.

Today, we have entered the new air era, a period in which the airplane is an important part of our lives. It will not displace the automobile, bus, train, or ship, but it is creating an important great, new, world activity in travel and transportation, and it will provide interesting employment for great numbers of persons. Many boys and girls in school today later on will be engaged in flying and in the ground activities of airport and airway operations, communications, and the weather reporting that is so vital in aviation. Some will be needed as engineers in the designing of new types of planes, engines, instruments and airports. The Government will employ many who will supervise licensing, and constantly check pilots, equipment and airports. All this will be a great new activity superimposed on, but not replacing existing activities.

For many years colleges have offered a semester or more of meteorology. A great many high schools are now including it as a one-semester course in the junior or senior year. This appears entirely justifiable because of its importance in the present war and in the peace to come. Much has been learned about meteorology in recent years because the airplane has done much to develop the science. On the other hand, meteorology has played an important part in the development of the airplane.

As an indication of the importance of meteorology in flying we may point out that it comprises about one-third of the curriculum of the elementary pilot training courses, and is given further study in all advanced pilot courses. High schools offering a pre-flight course of one or two years devote a semester to meteorology. High schools and colleges are better able to offer courses in meteorology than in any other of the aeronautical subjects, because to some extent the subject is not new in the curriculum.

The accompanying illustration shows naval aviation cadets receiving aerological (meteorological) instruction at Pensacola, Florida. The Naval Air Station

(Continued on Page Thirty-one)

—*Official Photograph, U. S. Navy.*

The Aerological Department of the Naval Air Station, Pensacola, Florida, demonstrating to a group of Aviation Cadets how instruments are sent aloft for weather data.

Adventures in Research

● By Dr. Phillips Thomas
RESEARCH ENGINEER, WESTINGHOUSE RESEARCH LABORATORIES, EAST PITTSBURGH, PA.

Through his popular radio program the writer of this paper is probably doing more than any other single person to make America conscious of the scope and achievements of scientific investigation. He accomplishes it not only painlessly, but pleasantly. In simple words and by well selected analogies he teaches scientific facts, explains theories, and makes his listeners understand more clearly what scientific research really means.

Dr. Thomas spends as much time on the lecture platform as in his laboratory, speaking before some 50,000 people annually. His special field of research is electronics and light-sensitive devices.

The Editor has been one of Dr. Thomas' radio listeners for some time, long enough to realize what a valuable teaching tool the program can be.

Better tune in!

●

Most of us can remember when boys and girls satisfied their scientific curiosity by mounting insects or pressing oak leaves. Now the scene is changed. Today young men and women with scientific leanings are more likely to build themselves intricate radio devices or conduct elaborate long time experiments with plastics.

The reasons are obvious. As the findings of scientific research penetrated deeper and deeper into our everyday life, scientific knowledge and the scientific way of thinking became more and more an essential part of our culture. The schools saw this and gave science a more prominent place in the curriculum; and one by one the great scientific institutions of the country recognized their obligations to the society which was fostering them, and developed better and better means of publishing their findings. Newspapers, magazines and radio stations joined the schools in a concerted effort to make America more "science-minded." The scientific information which had been bound securely between the covers of textbooks was becoming common knowledge, and boys and girls could feed their scientific appetites from a dozen different sources.

The radio program, *Adventures in Research*, produced by the Westinghouse Research Laboratories, is an example of an educational feature put forward by an industrial organization whose own adventures in research have made it one of the foremost electrical manufacturers in the world. It is a weekly radio program the purpose of which is wholly educational. Taking its place alongside companion projects of the company—publication of science teaching aids for use by teachers and students, article writing for magazines and scientific journals, annual scholarship awards—it aims primarily to assist in the growing process of making America more conscious of the scope, the achievements and the future of scientific investigation.

The program is a series of fifteen-minute interviews on topics of general scientific interest. It tries to present in language which can be understood by layman and student alike the up-to-date findings of research in a wide variety of scientific fields, from electronics to astronomy, and the new horizons which have been opened up by them.

Dr. Phillips Thomas (right) with Paul Shannon, the interviewer who represents "the man on the street," rehearsing a script for "Adventures in Research."

On the program we attempt to create the atmosphere of a research laboratory rather than a lecture hall. Whenever possible, we clarify laws and principles and theories by concrete examples, applications and demonstrations which can be plainly and readily visualized by the listeners. In other words, we do our best within the limits of the interview form to dramatize our lesson.

(Continued on Page Twenty-four)

Science Plays on the Air

● By Carl L. Swift
SCIENCE DEPARTMENT, ROBERT K. TOAZ JUNIOR HIGH SCHOOL, HUNTINGTON STATION, LONG ISLAND, NEW YORK.

This article deals with the successful broadcasting activities of a group of Buffalo science teachers with whom Mr. Swift was formerly associated. He writes mostly in the past tense since he is now located near New York, a fact that will interest teachers in the metropolitan district who may care to try the broadcasting of science plays, since he generously offers to give personal help to those schools or stations which request it.

To such teachers we suggest the purchase of the inexpensive booklet of scripts mentioned in this article. It is reviewed in another place in this number.

Here is an extracurricular activity that can be as beneficial to the teacher as to the pupil.

●

Today, radio as an educational tool is an accepted fact. National networks and local stations are providing worth while educational programs both on-school time and off-school time. Certain phases of the educational radio program are especially adapted to the broadcasting medium. Masterpieces of literature and music are brought home to many people by outstanding actors and artists. A teacher can plan to avail herself of educational broadcasts on various topics during the daytime, or she can assign radio listening as "homework."

Radio can be a direct educational tool or a subtle one. Certain "school of the air" programs are especially designed for school use, while others are a worth while though less obvious form of teaching. Certainly, no one should underestimate the force of the radio when used for propaganda, really a form of teaching.

Radio education is organized on a large scale. There are professional directors of radio education, directors of radio workshops, and supervisors and chiefs whose main function is the preparation, integration, and dissemination of educational materials by radio. These officials with their monetary, educational and broadcasting wealth are doing a good job in making educators radio-conscious.

In the science field there are many varieties of educational programs. We have talks by famous scientists, science in the news, new developments in science, dramatization of the lives of famous scientists, and many other types. This article is an account of a new type of educational science program, a program based on plays using child actors,—boys and girls from your own classes. This program, called the *Science Club of the Air*, is now in its fourth year on the air in Buffalo, N. Y. A group of enterprising science teachers, without benefit of extra time or money, offer this 15-minute broadcast each Saturday morning.

Purpose

One of the main reasons for inaugurating this series of science plays was that we wanted to assist the teacher, especially the elementary teacher, who had a meager background in science. All science teachers, both elementary and advanced, realize what a difficult job it is to answer the scientific questions of eager pupils. Since localities and states have made science a definite part of the elementary program, we felt that these broadcasts would give the teacher, especially the rural elementary teacher, more confidence to learn with her pupils. To assist the teacher, many guides, references and added materials were compiled and prepared for her use.

The second reason for the broadcasts was to enrich and enliven science teaching at all levels. An author and statesman once said that a collection of facts is not a science any more than a collection of bricks is a house. To present facts only, without the embellishment of various proofs, correlated ideas, interwining relationships, and practical applications, is poor teaching. One of the Science Club's broadcasts on air pressure, for example, brought in ideas about the weather, barometers, airplanes, and the familiar egg-in-the-bottle experiment. Such difficult topics as buoyancy and humidity were very simply explained and demonstrated in the studio. The broadcasts tried to bring hard-to-teach and difficult-to-learn topics down to an elementary, non-technical level.

A third reason for the broadcasts was to build a more discriminating radio audience of children. We attempted to counteract, in a small way, the stupid, inane, blood-and-thunder type of so-called children's programs, especially those based on scientific facts and scientific inventions. We felt that unrealistic events should be replaced by real-life events.

Fourth, we wanted to advertise science. We wanted youngsters to increase their liking for science and all that it implied. In the words of the announcer each Saturday, the broadcasts tried ". . . to help you to understand and appreciate this fascinating world around you." We wanted to teach them to think and act scientifically. We wanted them to understand and apply the scientific methods which were characteristic of the careful thinking and planning of our famous scientists and research workers.

Fifth, we wanted to create a new approach to the teaching of science, based on a keener awareness of

the youngster. The broadcasts would enable the student to contribute more to his class, thereby creating better learning situations for all. The programs also attempted to serve as an introduction to science for younger listeners, and especially those not being instructed in science.

Science Plays

Each broadcast consisted of an original script in the form of a play written by a teacher. The scripts, with an element of common sense and humor in them, dealt with different topics of science, such as air pressure, water, heat, light, sound, food, electromagnets and so on. They were carefully edited so they might appeal to both younger and older students. Scripts were based on the normal experiences of boys and girls in a cellar workshop, outdoors, or in school, who were trying to discover some things for themselves. The puzzling queries of one of the actors sometimes set the stage so that his "more-learned" pal was able to do some subtle teaching.

Two or three experiments that could be done simply at home, were an integral part of each script around which the action centered. For example, in the broadcast on air pressure, two of the experiments done before the microphone by the youngsters were the inverting of a glass of water with a blotter on the glass, and the putting of a hard-boiled egg in a bottle. The making of the necessary sound effects sold the program to many youngsters.

Another feature of many of the scripts was the "hanging" question to be solved by the listener and then sent in. In the air pressure broadcast the question was how to get the egg out of the bottle. Many replies were received and the youngsters' names read over the air, but the prize winner came from a little seven-year-old girl who wrote in big, bold letters—"break the milk bottle."

Sometimes prizes, such as toy helicopters, etc., were offered for correct answers. Trips to places of scientific interest were awarded to students answering questions correctly. At one time a trip included the close inspection of the interior of an airliner at the airport. When we arrived we saw all the airliners leaving, without any passengers, to assist at a snow-bound airport many miles away. However, we did get a very good explanation of the control rooms of the airport. As part of some broadcasts, boys and girls were interviewed who had outstanding or unusual scientific hobbies. At one time a script was woven around a boys' Bird Club. The excellent calls given by the boys and their instructor were a real treat.

At various times during the year the broadcast was in the nature of a science quiz program. Boys and girls from different localities who had sent in acceptable questions were included on these unrehearsed programs. Questions about experiments were included also. A humorous incident arose, relative to iron money, when it was discovered that a magnet attracted a Canadian nickel but not an American nickel.

After each broadcast was off the air, a forum lasting up to half an hour was held in the studio. In the carefully-planned forum, some of the broadcasted experiments were repeated by the actors, more explanation given, and other experiments relating to the topic were performed. The emphasis was on the idea that the experiments should be tried out at home. Oftentimes lively discussions arose and interesting questions were asked by both fifth graders and tenth graders. At one time over 360 students participated in a forum.

It will be noticed that the boys and girls took part in the entire proceedings. They were the actors in the plays, they were the contestants in the quizzes, they were the young scientists interviewed. The only adult participation was by the director and the guest teachers. Here then is a science program built around children, and also actually using children. The participants were ordinary children with ordinary voices, their ages ranging from nine to sixteen. There were farm boys and girls, and city boys and girls, pupils from small schools and pupils from large schools. One Saturday we announced that an entire school would witness the next broadcast, and sure enough the fifteen pupils from a one-room rural school were there. Many boys and girls saw the broadcasts although the studio audience was limited to 40.

Planning the Broadcast

A group of teachers acted as advisors to the program, with one of them acting as director. Teachers volunteered to write the scripts and to use their pupils in the plays. The finished plays were then reviewed and reworked by the group, and then rewritten. The next step was the timing. When a play was believed to be ready, it was rehearsed again in the studio, voices rechecked and matched and chosen for best effect, and sound effects carefully checked. The sound effect of pouring water requires more practice than just pouring water. After more rehearsals by the actors in their school, the final rehearsal was held just before the broadcast. No attempt was made to use extraordinary children or extraordinary voices.

The director planned each program, conducted the interviews, and the quiz program, and so on. It must be remembered that everything that was done was done on a volunteer basis. The entire series was put on by a small group of professionally-minded teachers who devoted their after school hours and Saturdays and Sundays to the work. All the clerical, organizing, rehearsing, and planning details were attended to by the director and his assistants. Last year the broadcasting studio undertook the answering of the fan mail and the necessary clerical and mailing costs.

Results

A commercial program is judged by the success of its advertising as reflected in the sale of its products. No such measuring device is possible here. Over 700 pieces of mail were received during one series of 15 broadcasts. Over 600 Science Club of the Air buttons

(Continued on Page Twenty-six)

The Camera Club

• By Russell C. Boyles
CAMERA CLUB SPONSOR, SENIOR HIGH SCHOOL, READING, PA.

Here is a modest story written by the experienced advisor of a camera club that really functions, a club that attracts not only photographic hobbyists, but also serious workers who hope later to earn a living with their cameras.

Teachers who have not studied the matter carefully will be glad to learn of the numerous opportunities that can be found for club members to picture school life in its various phases, and the possibilities there are of making the club sustain itself financially.

The accompanying illustrations are made from photographs taken by club members.

Whenever like needs make themselves felt to a sufficient number of students, a gathering of those interested results, to discuss and work on their common problems. The natural outcome is a club. From such a situation will come the ideal club, one from which will be obtained the maximum of effort and output for all the members participating. To be the advisor of a club founded and functioning in this manner is the dream of all teachers engaging in extracurricular activities.

But this procedure is the exception rather than the rule.

Practically all science clubs are the outgrowth of conferences between pupils and teachers. From the judicious suggestions of teachers to pupils who come to them for information about their hobbies or their difficulties in science subjects, is planted the seed of the desirabiltiy of forming a club in which such points can be discussed and further applications made.

The next step is an interview with the principal or guidance officer of the school to request permission to organize such a club, in this case a camera club, and to inform the student body that such a club is to be established. Thus, a club can be born very easily, whether it be a hobby club or an academic club. Today, it should be especially easy to form science clubs in almost any desired number and with any range of activities, for increased emphasis is being placed upon these offerings in all our secondary schools because of the need for men and women trained along scientific lines.

The formation of the club is perhaps the easy part of the task. Far greater energy and initiative on the part of the advisor will be required in organizing and operating it.

When permission has been granted, and a club is about to function, certain points of its operation must be discussed with the administration. The cost of operating a camera club under ordinary conditions amounts to about one dollar per person enrolled per school year, when each purchases his own paper and films. If greater activity than usual occurs, and we can expect this to happen now when calls are being sent out for trained personnel by the Army, Navy, Air Corps, and other governmental services, the cost may well rise to from two to three dollars per person. Then there is the new equipment which will be necessary and the replacement of that which has been worn out through use or has been broken by handling, and the using of chemical supplies which are necessary for all developing, printing, enlarging, reducing, intensifying, and any other special solutions which are used.

It is plain that a definite policy must be adopted for the operation of such a club at the time of its organization. A number of plans can be worked out to take care of expenditures, ranging from complete coverage by the school authorities to payment of all expenditures by the club members. The plan that is to be used must of necessity be worked out by the individual school to meet the needs of the club itself and to comply with the policy of the school with respect to extracurricular activities.

The achievements of any camera club are dependent upon the initiative of the advisor and the club members with reference to the photographic needs of the school. After a club has begun to operate there are several essential goals which must be attained as quickly as possible. They are:

Faculty Play — Stage Setting

1. To develop the entire club personnel so that each member is able to take any undeveloped negative and produce from it an acceptable print.
2. To train an adequate number of members to operate motion picture and slide projection machines.
3. To establish a thoroughly trained crew of operators who are able to function without a great deal of supervision as a crew for obtaining group photographs.

Student Portrait

4. To have available at all times members who can be called upon to secure pictures of all school events.
5. To conduct continuous seminars for the improvement and advancement of all members.

Let us examine what these five goals represent to the club, and the results which follow from the attainment of these goals.

The ability of a camera club to become financially independent rests wholly upon the adequacy of its personnel in the fundamental processes of developing and printing. Every school today presents numerous opportunities for the camera club photographer. Football games, basketball games, track meets, club activities, year book activities, and the school paper are a few of the more notable opportunities from which pictures may be obtained and for which there is a ready sale in the school. Prices for prints, of course, are much lower than commercial work since no large overhead has to be met, for each member of the club gives his time free to produce the orders received. The small profit per picture which is obtained in this manner soon produces a considerable working surplus which can be used for the purchase of needed supplies and additions to the equipment.

The year book is the source of the greatest revenue since extra prints from club photographs, which are to be used as cuts in the book, find a ready sale among the club members. Needless to say, not very many prints and practically no negatives may be spoiled during the photographic processing or the small profit will be wiped out, especially in smaller schools. The cost of negatives for year-book work is usually assessed to the publication, and this covers the major expense of any club photographic undertaking. Advisors will find that if projects of this kind can be carried out by the club, the motivation of activities must sometimes be curbed instead of encouraged. Club members, because they are interested in doing this type of club work, have a tendency to do better class work in order that they may be excused from study halls to work in the dark room.

The use of all visual education apparatus normally falls under the jurisdiction of the camera club advisor. This apparatus will consist of slides, slide projectors, film and film projectors, both of the silent and sound varieties. In order to keep this apparatus running at maximum efficiency, trained personnel is required so that reports to the advisor will allow for the repair of minor break-downs quickly. There must be trained for this work at least two club members for each period of the school day so that always at least one person is available at a moment's notice to go out on an assignment. This training insures that the job will be done correctly and with a minimum of confusion.

In connection with obtaining group pictures for the year book and other school activities, a camera crew trained in grouping and arrangement must function smoothly as pictures are called for at unexpected times and on very short notice. This crew has under its control the equipment used for this purpose and for which they must have on hand supplies, such as film, flash light bulbs, flash light gun, electric trailers and studio lighting equipment. For these assignments five or six persons must be given thorough training to prevent injury to equipment and spoilage of supplies.

In addition to this trained crew, other members owning cameras which are adapted to photographing school events and who can usually be found at these functions are assigned to photograph interesting incidents at these gatherings. These shots must be developed and glossy prints submitted to the sponsor no later than the day following, so that any calls for illustrative

(Continued on Page Twenty-nine)

Graduate Students in Agricultural Science

• By E. M. Hildebrand, Ph.D., *(University of Wisconsin)*
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This straight-from-the-shoulder article has needed writing for a long time. Although it deals with agriculture, much that Dr. Hildebrand has to say applies to other fields as well.

Delightfully written, this paper is filled with keen observation, sound thought and logical conclusions. There is even a touch of humor.

It will challenge your thought.

Do not pass it by.

The most serious problem facing the high school boy is the matter of choosing wisely the career on which he is to stake his future. The success or failure of many lives date from the adjustments and decisions made at this critical period.

The writer also faced this perplexing problem over twenty years ago, and what has happened in the intervening years has so definite a bearing on the subject of this paper that he must with apology perforce, draw frequently on personal experiences and judgments in an endeavor to illuminate certain points where accurate data are lacking.

The same sources of guidance were operative then as now, namely, parents, pastors, school teachers, relatives and friends. Coming from the farm and being intensely interested in agriculture, it was only natural to favor some phase of agriculture as a career, and a decision was made to devote my life to the service of agriculture, despite the sad economic plight of farmers and against the advice of many from whom advice was sought.

My grandparents (German-Irish stock) had come to this country in the 1840's and settled on farms in Wisconsin. Briefly, my Irish relatives advised getting educated so I would not have to work any more, meaning literally leaving agriculture for the city. The relatives of German extraction were more loyal to the soil and advised against wasting time on a college or book education, but there were a few exceptions who thought a college education was a good thing because you could become a better farmer, or a teacher, and have some influence on agriculture.

The beloved local pastor was indeed interested in the idea of higher education for the young people, but he was equally emphatic that there was no alternative to attending a Catholic college, agriculture or no agriculture. Going to the atheistic state university would imperil one's Christian faith, which then, as now, I aimed to live by. I compromised and followed the advice of the high school agriculture teachers, and attended a State Teachers College which specialized in training agricultural teachers for high schools. After several years of teaching experience in high school, I entered the State University and completed my training for my present career, as a plant pathologist.

Approximately 20 per cent of the students at the so-called "atheistic" institution were Catholics. True, there was a minority of atheists, communists, agnostics, etc., in addition to the many professing the various Christian faiths and Judaism.

This only goes to show that the conflicting forces in the world are operative in miniature in the university community. Going into seclusion, or segregation, will neither remove these forces nor train one to combat them. The Student Chaplain believed that the place to combat the enemies of the Christian way of life was where these forces operate. Consequently, many serious discussions were held and researches made on the merits of the challenges met in the classrooms on the campus. Without exception, there was a convincing answer or explanation for every challenge, which meant that there was no real conflict between true science or learning, and true religion, and this could not help but strengthen the faith of those who participated.

The graduate school of the same institution was marked by the rarity of Catholic students. Here there was much less of conflict because emphasis was on research in specialized branches, with the study of the accumulated literature forming the foundation. The specialist in course of time still remains a layman in all but his speciality. The rarity of Catholic graduate students, "apprentice scientists, or scholars" had a parallel in the rarity of Catholic scientists and scholars on the university staff.

The feeding mechanism was not working, for some unknown reason. This disparity must have root somewhere. No country in the world has so much to offer in the way of educational advantages, as ours. Yet these advantages, particularly as applied to the opportunities in the secular universities, are being sidestepped by members of the greatest moral and spiritual force in the world. The growth of the state universities and colleges of agriculture is the result of the growing appreciation of the necessity for increased education in a world of ever-increasing complexity and diversity. There is nothing unchristian about it. If Jesus were to come on the scene in person today, He would in all probability start in on the professors.

The university professor is victim of as many vices and virtues as are his brothers in other walks of life,

yet he is in a distinctly influential position as a propagandist, whether for good or evil, because of the many young student minds who come his way for instruction.

After six years in this atmosphere, it was my fortune to move to another section of the country and enter on duties as a staff member in another tax-supported state agricultural college. Here again was found, if anything, even a greater disparity between the relative percentages of Catholics in the undergraduate, graduate, and staff levels of the college and university. Still further inquiry, on visits to numerous institutions throughout the country over a period of ten years, has seemed to bear out the same general pattern. This rarity of Catholic scientists in the state universities, colleges of agriculture, and experiment stations, challenged the writer to suggest this as a topic for discussion by the *Catholic Round Table of Science* at one of its annual sessions. Before this came to pass, however, I accepted an invitation to present my views in this brief article.

To get a more accurate check on the role of Catholic students in agricultural science, a survey was made of representative agricultural institutions over the nation, with interesting results.

Replies were received from eight, or nearly half, of the Chaplains of the institutions canvassed. Although distinctly preliminary in nature, sketchy, and in many instances incomplete, the survey rather eloquently bears out the writer's previous cursory observations and deserves brief analysis.

The trend of Catholic students in the colleges where agriculture is taught has been upward and fits in with the rather general upward trend in total enrollment in these institutions.

The percentages of Catholics in the respective student bodies is considerable, but always less than the ratio of Catholic citizens to the total population of the states. This discrepancy was to be expected since the Catholic colleges also draw considerable numbers of students.

Obtaining accurate counts or estimates of Catholic undergraduate and graduate students majoring in agriculture was difficult, if not impossible, perhaps because the Chaplains have not considered such data pertinent in their work. However, the cases where figures were obtained shed some light on this point and indicate rather definitely the tendency for disproportionately small numbers of these students to major in agriculture, either as undergraduates or as graduate students.

The role played by Catholic professors in these institutions was likewise disproportionately small, which was to be expected, in view of the rarity of Catholic graduate students in these institutions.

That Catholics may some day assume their proper role in the agriculture of our country would seem to hinge on the removal of the inhibitions, or misconcep-

(Continued on Page Thirty-four)

TABLE 1. A SUMMARY OF THE QUESTIONNAIRE REPLIES RECEIVED FROM THE CHAPLAINS OF CATHOLIC STUDENTS OF EIGHT AGRICULTURAL INSTITUTIONS ON THE ROLE OF CATHOLICS IN AGRICULTURAL COLLEGES.

	NEW YORK (Cornell)	PENNSYLVANIA (Penn State)	MICHIGAN (Mich. State)	ILLINOIS (Univ. of Ill.)	IOWA (Iowa State)	KANSAS (Kan. State)	UTAH (Utah State)	TEXAS (A. & M.)
Total students	6500	6000	6300	9600	6066	3269	1714	8000
Total Catholic students	848	867	775	1340	560	205	31	771
Percent Catholic students	13.0	14.4	12.3	14.0	9.2	6.2	1.8	9.6
Catholic undergraduates	793[2]	842	—	1297	—	203	31	—
Catholic graduate students	55[2]	25	—	47	—	2	0	—
Catholic undergraduates in agriculture	220[2]	—	—	90	—	5	15	—
Catholic graduate students in agriculture	20[2]	—	—	12	—	0	0	—
Rank of Catholics among religious denominations	3rd.	—	—	2nd	4th	4th	2nd	3rd
Trend in Catholic students[1]	Upward	Upward	Upward	—	Upward	Upward	Down	Upward
Catholic professors on staff	11	21[2]	15	150[3,4]	20	8	1	—
Percentage of staff Catholic	1.0	3.0	2.0	7.5[3,4]	3.0	3.0	1.0	—
Percentage of state Catholic	23.2	21.4	15.5	22.2	11.8	10.1	3.0	10.6
Principal background of Catholic people	Urban	Urban	Urban	3/4 Urban	Urban	1/2 Urban	3/5 Urban	Urban
Catholic students[5]	—	—	—	—	—	—	—	Rural

[1] In the majority of cases the upward trend fits in with the rather general increase in the total enrollment.
[2] This is an *estimate*—not an accurate count.
[3] Including Instructors.
[4] This figure is an estimate and seems unusually high.
[5] Data are lacking in most cases on the principal background of Catholic students in these institutions, but my guess is that it is distinctly urban.
— Data not available or not given.

From Stars to Atoms
At the Buhl Planetarium

• By Arthur L. Draper
DIRECTOR, BUHL PLANETARIUM, PITTSBURGH, PA.

The planetarium is one of the most inspiring instructional helps at the command of the science teacher. A comparatively new invention, so costly that there are only a few in the world, the projection planetarium reproduces in a great darkened dome the heavenly bodies as they move across the sky.

But a planetarium is more than a machine to teach the science of the sky. It is a great institution of wide interests reaching out in many directions to teach science to both layman and student.

Read here what the Buhl Planetarium, America's finest, has done to cause it to be regarded not only as one of the city's greatest attractions, but also one of its most valued teaching institutions.

Most science teachers will agree, I believe, that science education in the secondary school must not stop at the school steps. The student must learn science from his books at home, from magazines, and from his own tinkering with electrical apparatus or chemicals or insects. In addition, most cities have institutions dedicated to science understanding, and a large part of their effort naturally goes into helping boys and girls of high school age.

The Buhl Planetarium and Institute of Popular Science is such an institution. One of the aims of those of us who serve on its staff is, of course, to help adults understand the meaning of science in this complex world of ours. For most mature persons of the present day grew up in an age when science was not, as it is today, a part of one's everyday experience. Adults are important in the program of such an institution. But, most certainly, they are no more important than the boy and girl.

Perhaps it is hardly necessary to point out that as a tool in science teaching the modern Planetarium has become, as it should, a versatile institution. It reaches out into many fields of science besides astronomy. The word "planetarium" itself is a hang-over from early days, coined to describe a machine for demonstrating the motions of planets. The optical instrument of today known as a "projection planetarium" is able, of course, to reproduce realistically in the man-made heavens not only the planets but the other heavenly bodies of the night and daytime sky, such as sun, moon and stars. Actually the word "planetarium" now has come to mean not just the optical machine that does these things but the institution which houses it.

And that is where the boy or girl can be led from the all-comprehensive science of astronomy into other specialized fields—whether the field of geology (the study of our planet as a world), or of biology (the study of life upon it), or of chemistry and physics (the study of the materials making up planets and all other bodies in the universe as well).

I surely do not intend to minimize the value of the projection planetarium, since in presenting the science of the sky it is a marvelous apparatus with impressive possibilities. Everyone is familiar with its ability to speed up time, to let a day or even a year pass in a few seconds. In that way a long astronomical story can be quickly told. Nor in the Planetarium sky do limitations of geography, or difficulties of travel bother us. We can quickly move to any spot on the earth we

THE BUHL PLANETARIUM AND INSTITUTE OF POPULAR SCIENCE
Cuts, Courtesy Buhl Planetarium.

wish, to see the changing aspect and behavior of the heavenly bodies. Or, with equal facility, we can journey ahead in time to see the sky as it will appear sometime in the future, or back in time to observe astronomical events that occurred hundreds of years ago.

I might cite our annual Easter sky show, which will run this year through most of the month of April, as an interesting example of the projection planetarium's capabilities. For this show, always one of our most popular productions in the year, the projector can be run back to the time of Christ, and we see the heavens that shone on Palestine when the Crucifixion took place.

Then too, for the teaching of celestial navigation the projection planetarium is the ideal instrument. For many months now the Buhl Planetarium has been conducting navigation courses for young and old. Basic and advanced courses in navigation have been given for adults, and special courses for high school students. Registration for all courses, by the way, has been not merely gratifying. It has been surprisingly, significantly high.

ARTHUR L. DRAPER
Director, Buhl Planetarium

But leaving astronomy and getting into other sciences, let me mention as another medium of science teaching the demonstration lectures of the Buhl Planetarium. These were initiated with the idea of making available to high schools the facilities of completely equipped laboratories in the fields covered. Last year's response and results inspired an expansion of the program for the current series of demonstrations in physics, chemistry, biology and general science. These are planned so that they co-ordinate with classroom work. Thus a physics class, after completing its study of electricity and magnetism, may come to the Planetarium to see the demonstrations in that field.

I think that a perfect example of the work that an institution such as the Buhl Planetarium can do in helping the boy or girl of high school age is our annual Junior Science Fair. This year's Fair (May 1-15) will be the fourth held in the Planetarium, and every year the quality of the exhibits, the interest of teachers, parents and students, and the satisfaction of the staff members in their work in connection with the Fair has grown.

The mechanics of the Junior Science Fair are simple. Boys and girls, 12 through 18 years of age, are invited to plan and build exhibits which demonstrate or explain some aspect of science of interest to them. These exhibits are brought to the Planetarium, installed, and shown in public exhibition for a period of approximately two weeks. That there is public interest in the work of these youngsters is convincingly demonstrated by the Planetarium's attendance figures, for we always have a larger-than-usual attendance at the Planetarium during the period of the Fair. Before the Fair opens, a Board of Judges, made up of outstanding men of science of the Pittsburgh region, carefully goes over the exhibits, and awards prizes to the best of them.

What, we might ask, is the effect of the Fair upon the young people who participate in it?

For one thing they get the genuine satisfaction which comes from seeing people look at their work. That is worth while. All of us need that kind of encouragement. Indeed, I believe that a person who does good work deserves it.

Second, the boy or girl building an exhibit sets out for a goal, reaches that goal. Here is stimulation for the development of perseverance.

Third, we cannot overlook, of course, the fact that the boy or girl building an exhibit learns new things about science. It may be he must "read up" on some phase of the field in which he is working. Or, because he is explaining some phase of science to persons unfamiliar with his field, he must think clearly. Those of us who work every day with the interpretation of science—that is, its interpretation to the average person—know very well that we cannot explain a scientific fact clearly unless we understand it completely ourselves. In preparing explanatory labels, for example, the young exhibit builder must work at his phraseology until it becomes completely clear. He may submit his labels to his friends or his parents, and ask them if the labels are easily understood.

And then there is the matter of craftsmanship. There have been successful scientists who were inept with tools. They have been, for the most part, the theoretical scientists, men and women who work skillfully with ideas. But most successful scientists are reasonably able craftsmen. The biologist must be able to manipulate his laboratory apparatus well. The physicist must know what machines can do. The chemist usually must be able to follow a problem through to its practical applications. Exhibit building is almost ideal for the development of a science of craftsmanship in the young scientist, for it demands skill with hands and precision in accomplishment.

I believe that readers of the *Science Counselor* might be interested in knowing the names of some of the

(Continued on Page Twenty-eight)

The Nutritive Value of Dextrose

● **By I. Newton Kugelmass, M.D., Sc.D., Ph.D.,** *(Johns Hopkins University)*
MEDICAL CONSULTANT, CORN PRODUCTS SALES COMPANY, NEW YORK, N. Y.

Here is authoritative information about dextrose, the natural sugar of the body, food energy in its purest form. Added to foods it improves flavor and texture and increases food value. The Government has included it in Field Ration K, which is used by soldiers in emergencies.

How important this sugar is may be judged from the statement of an eminent scientist that ". . . . . not a twitch of our muscles, not a throb of our hearts, not a flash of our imagination but is produced by dextrose."

Dr. Kugelmass discusses the chemical constitution and commercial preparation as well as the physiological action of this important food.

●

The Chemical Nature of Dextrose

The early chemistry of dextrose, particularly the stereochemistry of the spatial relationship of groups about the carbon chain, was developed by Emil Fischer in the latter part of the nineteenth century. He studied the fundamental reactions of dextrose by which its dual alchoholic and aldehydic nature was ascertained. Later, Tollens introduced the ring structure for sugars in order that the existence of two well defined series of compounds might be explained. The fact that gluconic acid was easily converted into δ-glucono-lactone suggested that the similar ring (lactal ring) in the sugar series was also of this structure; that is, consisted of one oxygen atom and four carbon atoms. This lactone ring structure of dextrose was well recognized until the isolation of a third series of derivatives by Fischer led to a reconsideration of the problem, and in 1914, W. N. Haworth of the University of Birmingham, in England, showed that the common sugar derivatives previously isolated by Fischer existed in six-membered, or delta-lactal rings. The 5 and 6 membered structures were thus renamed the furanose (from furan) and pyranose (from pyran) ring systems. Haworth also showed that the third series of derivatives belong to the furan or five-membered ring group.

Dextrose is known chemically as *d*-glucose, or dextroglucose, of which "dextrose" is the contraction. Unfortunately, the *U. S. Pharmacopoeia* has defined glucose as corn syrup, which is a mixture of dextrins, maltose and dextrose, and has entirely different properties from the sugar, dextrose.

Pure dextrose as it is presently available is a white, crystalline compound of definite chemical structure now defined by the *Pharmacopoeia* as an entity distinct from any other sugar. The physical properties of dextrose are characteristic of the sugar series. It crystallizes from water, alcohol, or other polar solvents in the monoclinic or orthorhombic systems, depending upon the isomeric form. Dextrose is only about three-fourths as sweet as cane sugar, or sucrose, and is soluble in water to the extent of 100 parts per 100 parts of water at 20-25° C.

Several definite forms of dextrose are known. The commonly occurring ones are the alpha hydrate and the alpha and beta anhydrous sugars. The latter two compounds differ structurally only in the position of the hemiacetal hydroxyl or reducing group with respect to the ring and are therefore known as space or stereoisomers. They differ in their physical properties particularly with respect to optical activity. Alpha dextrose, anhydrous, has an optical rotation of +112.2°; beta dextrose, anhydrous, has a rotation of +18.7°. When either form is dissolved in water and the solution is allowed to stand, the rotatory power changes with time until a constant value of +52.5° is ultimately obtained. This phenomenon, known as mutarotation, indicates that the two forms are in substantial equilibrium in solution. A third form of dextrose which contains one molecule of water associated with the alpha dextrose molecule, is the normal dextrose of commerce. The three forms differ in rate of solubility, the beta dissolving much faster in water than either the alpha anhydrous, or alpha hydrate, or sucrose, while the alpha hydrate is the slowest in respect to this property.

Crystallization of dextrose must be very carefully controlled to obtain a complete separation of alpha and beta dextrose. This is usually done, especially in the preparation of the anhydrous sugars, by rigid temperature and concentration control. In general, the beta form is crystallized at much higher temperatures than the alpha form. The fact that the alpha form is the one usually commercially available is of little practical importance from the physiological point of view since the equilibrium mixture obtained in solution is usually employed. Even if only one isomer is capable of reacting under the particular set of conditions and is subsequently removed from solution, the equilibrium of the system is maintained by shifting residual isomer back to the normal equilibrium mixture. The presence of two isomers of dextrose is disregarded in discussions of its physiological effects and dextrose is considered a single sugar.

Commercial Preparation of Dextrose

Dextrose is prepared commercially in large quantities by hydrolyzing corn starch in the presence of an acid catalyst. The usual procedure is to suspend 20

(Continued on Page Twenty-five)

Leaf Form and Variation

Part I. Buckthorn-Grape Alliance

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This article, the first of a series, contains new scientific data that make it appear probable that there is no exclusive or definite rule for the evolution of leaf form, even within a generic relationship. The papers which are to follow give additional support to this tentative conclusion.

Sister Mary Ellen is one of this country's outstanding Catholic scientists, acclaimed for the literary excellence of her works as well as for their scientific accuracy. She is co-author of the popular Hauber and O'Hanlon college textbook of biology (1937), and author of the widely used "Fundamentals of Plant Science" (1941).

The drawings that accompany this paper are the work of Patricia M. Borgstrom and Marijane E. Anderson, two of Sister Mary Ellen's students at Rosary College.

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A leaf may be defined as an outgrowth from a stem. The typical leaf is green in color and, including the stipules, consists of three main parts, the principal and most persistent of which are the petiole and the blade. Some modified leaves, such as the bracts of the daisy and dandelion heads, deviate from the true leaf type in both form and function. The colored leaf-like bracts at the flowering apex of the poinsettia are a strong contrast with the true foliage of this plant, so much so, that perhaps the majority of people consider these showy foliar organs the "flowers." Many floral leaves (sepals, petals, stamens, and pistils) and other leaf homologues are so highly specialized, both morphologically and physiologically, that they are seldom thought of as leaves. Among the latter are the essential floral organs, that is, stamens and pistils; for these are really leaves (sporophylls) which have lost completely the appearance of foliage. This short paper, the first of a series, is limited to certain morphological types of foliage leaves and their variations as such.

Most textbooks of botany place special emphasis on the form of the leaf blade relative to its variation, its general shape, including the apex and base, the type of margin, and the arrangement and number of its segments, if the blade is compound. In the latter case, the leaflets or segments of the blade are described individually in terms which also apply to the simple leaf blade. A number of descriptive words are projected which are exact and pertinent to the several aspects of the leaf blade but, unfortunately, in too many books, these words apply to a series of sketches or diagrams which, like straw men, are without name or fame. They therefore demonstrate more or less abstractly the characters which the words qualify. This method of teaching a subject which should be definitely concrete is neither consistent nor satisfactory. It is necessary therefore to apply the several descriptive terms to real and specific leaves.

It is highly probable that there never have been two leaves exactly alike in all the world! Whoever tries by superposition to make any two leaves coincide exactly is almost sure to fail to accomplish his task. It is true nevertheless that among the leaves of some species, for example, those of the pines and other conifers, there is very close resemblance as to length, thickness, color, texture, etc. Also, the leaves of the lilacs, the willows, the poplars, and probably the majority of plants, show no well-defined nor great variations in form. This is true, despite the fact of the individuality of each leaf.

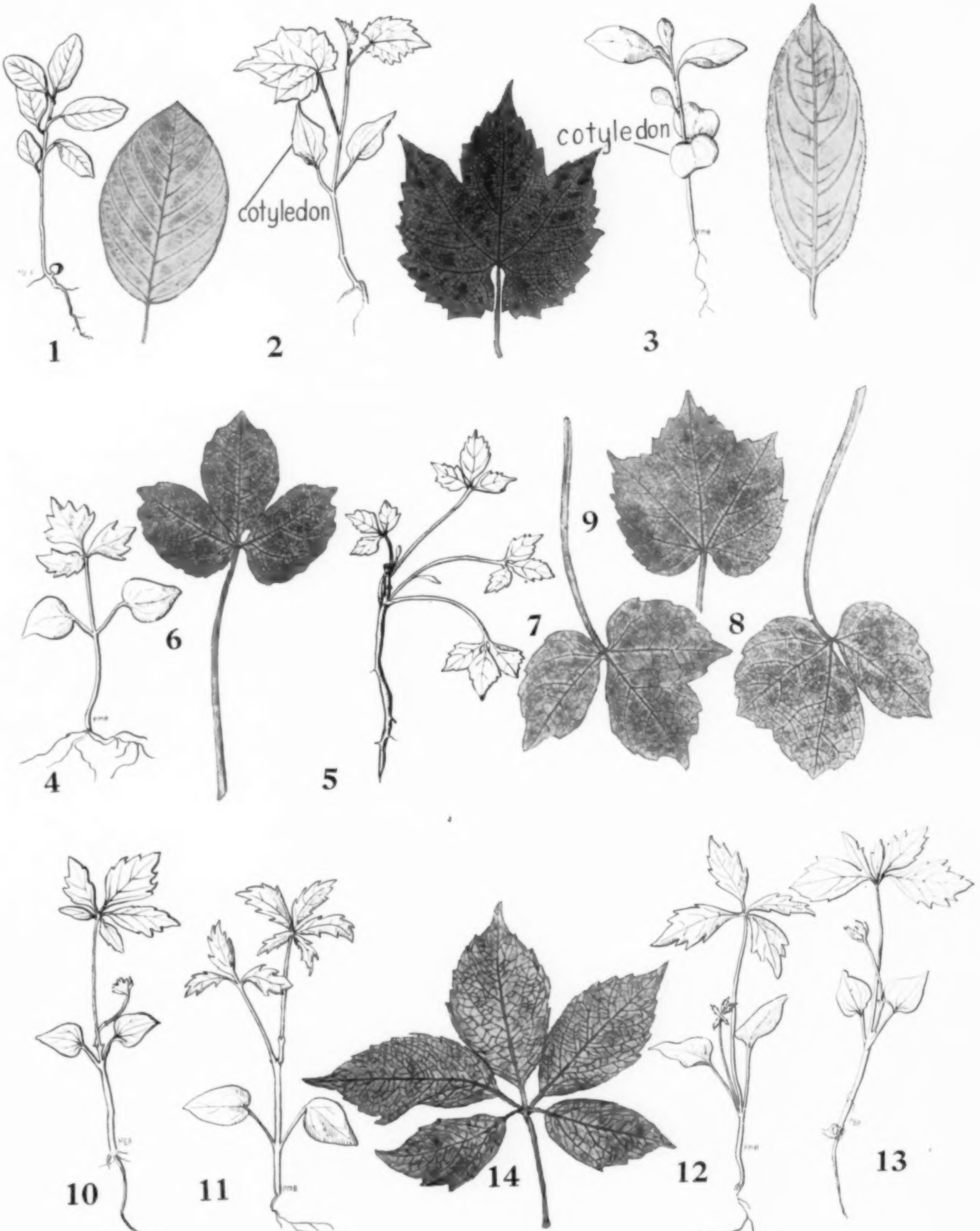
While the shape of the leaf blade is inconstant, with leaves, as with everything else, variation can be really appreciated only when we know something about what is considered as the normal or the typical leaf of a given species.

The only correct and satisfactory way to study the external structure of living leaves is to examine them *in situ*, that is to say, on the plants which bear them. Neither can one make an accurate description of the typical leaf of any species until the whole plant is examined. Even this method does not allow for variation due to environmental conditions, such as water supply. Some plants can adapt themselves to a great many conditions relative to habitat. As hydrophytes, their foliage may be considered typical; but, inasmuch as some of these plant species can live also as mesophytes, it is their foliage *par excellence* which makes the necessary ecological adjustments. Also, plants which can adapt themselves to xerophytic conditions suppress their foliar organs to mere vestiges of the leaves found on the same species growing in a mesophytic habitat.

Variation of leaf form may include the general differences between the juvenile leaves at the basal and those on the erect and apical regions of the stem, as in the bluebell *(Campanula rotundifolia)*. In some plants the lower or radical leaves may be stalked, whereas the cauline leaves may be sessile or decur-

Explanation of Figures.

1. Seedling and adult leaf of *Rhamnus Frangula*, a species of buckthorn; 2, seedling and adult leaf of *Vitis vinifera*, the wild grape; 3, seedling and adult leaf of *Rhamnus daburica*, another species of buckthorn; 4, seedling, and, 5, second year plant of *Parthenocissus tricuspidata* and 6-9, the four types of adult leaves of same; 10-13, seedlings, and, 14, the adult leaf of *Parthenocissus quinquefolia* (Virginia creeper or woodbine).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rent, as in the mullein *(Verbascum spp.)*. Finally, on a single stem, the gradation may be from stalked leaves to sessile leaves to the fusion of two opposite leaf blades into what is designated the connate perfoliate arrangement, as in the honeysuckle *(Lonicera Caprifolium)*. In water plants the submerged leaves are generally different in form and structure from those that float or emerge from upright stems—a feature which is well demonstrated in the yellow water buttercup *(Ranunculus aquatilis)*.

Both stem and leaf structure in strictly hydrophytic plants differ very notably from those of mesophytic plants. For example, *Potamogeton* and *Elodea*, both common water plants which are used for laboratory study, demonstrate these features adequately. Certain plant species which can adapt their structures to both water and land habitats and are therefore amphibious, sometimes spread by means of runners or rhizomes and will send up aerial shoots which, if they survive, may adapt themselves to a changed environment. These extraordinary adaptations to changes in habitat have sometimes led to confusion of species and names and therefore prove that the exact taxonomist has need of a definite and thorough knowledge of the ecology and physiology of his subjects. The article[1] entitled *Our Amphibious Persicarias* cited below is an interesting and instructive discussion which competently upholds this last statement.

Variation may also apply to the foliage of juvenile growths which include the leaves on cambial shoots or those borne on branches which originate from latent buds, as well as the leaves of the more strictly young plants or seedlings.

Leaves are generally symmetrical, that is to say, any leaf if folded lengthwise at the midrib, proves its two sides to be similar in size, contour, and all other respects. This is consistently untrue, however, in such trees as the elm, the witch hazel, the hackberry and the American linden in the leaves of which one-half of the blade exceeds the other in area owing to the lop on one side of the leaf base. The blades of these leaves are thus described as asymmetrical; and no matter how much they may differ from one another in size or in any other respect, they are usually similar in reference to their particular type of asymmetry. Moreover, only such leaf blades as exemplify this dextra-sinistral type of variation are usually designated as asymmetrical.

The paleobotanist or physiologist may account for the constant asymmetry and uneven growth in such leaves as the elm, the witch hazel, the linden, etc., by attributing it to the peculiar type of folding in the bud, and, consequently, to the greater advantage of one-half of the leaf as to hormones and food supply. If his speculation is correct up to this point, the scientist has next to explain the peculiar but apparently regular and uniform folding in the buds of these particular species.

There are leaves, such as those of the bur oak, which seem to be very erratic in their variations. These leaves, with the exception of a relatively few quite bizarre specimens, are generally more or less symmetrical and all of their essential characters mark them as oak leaves, some of which might well be mistaken for the leaves of the white oak or of some other oak species. If examined in the late autumn, however, the bur oak leaves manifest a distinct dorsiventrality which readily distinguishes them from those of the white oak. The autmun leaves of the white oak, for example, are papery in texture and both the upper and lower surfaces are similar; the dead bur oak leaves are, on the contrary, more leathery and the dorsal or upper side (the inside of the leaf when in the bud) is smooth as dressed kid, while the ventral side is of a suede appearance.

The leaves of the white mulberry are exceedingly variable in shape, ranging from unlobed symmetrical blades to all types of unpredictable and asymmetrical shapes. Other generally available plant leaves which show excessive variation are those of the ginkgo and the common weed called bitter nightshade *(Solanum dulcamara)*. In both these and other well known plants there is considerable difference in the shapes and sizes of the leaves on any individual plant but with more inclination toward symmetry than is true of those of the mulberry.

The sassafras presents a well-known example of leaf variation in which each leaf blade represents one of four main types: the two-thumbed mitten (generally more or less perfectly symmetrical), the right and left mitten, and the thumbless mitten which is an unlobed symmetrical leaf blade[2]. According to paleontological records, the oldest form of the sassafras leaf is the two-thumbed mitten type. It might well be maintained, however, that the thumbless mitten type of leaf blade is not recognized as a sassafras leaf among the fossil remains. Be that as it may, all four of the main types of leaf blade may be found on the same twig of our present sassafras trees and shrubs. According to the interpretation of the geologic traces, these right and left mitten leaf types are intermediate forms which appear to be transitional between the oldest fossil form and the most modern leaf type in this species.

Leaf variation may be described as *regular* when it seems to follow some general rule which results in one or a few distinct types, the individuals within each of which vary but slightly one from another, as in the sassafras, or in the Boston (Japanese) ivy which latter is discussed below. Such variation may be found among leaves on the same twig of the plant and therefore seems not to depend in any way upon external conditions. Whatever causes such radical differences appears to be due to internal influences; but, certainly, these influences may be the result of external stimuli which are not scientifically observable. All inconsistencies and discrepancies or whatever phenomena ap-

[1] Nieuwland, J. A. *Our Amphibious Persicarias*, Amer. Midland Nat. 2:1-24. January, 1911.

[2] O'Hanlon, M. E. *Fundamentals of Plant Science*, p. 66 (Crofts, 1941).

pear to us as irregularities, are due, no doubt, to our imperfect and very limited knowledge of physiology, cytology, and probably a host of other "ologies," yet unknown and unnamed.

We may also attempt to distinguish, somewhat arbitrarily, *regular* and *irregular* or erratic variations in leaves on the basis of their invariable or variable asymmetry; but if the leaves of a given species, such as those of the white mulberry, are inclined to eccentric and anomalous forms, this character is *regular* for the species, and it is the exception to this *irregularity* which immediately arrests our attention as something unusual or abnormal.

There is evidence from a number of species of plants which bear compound leaves that the more primitive of these species bore simple leaves. In the olive family (Oleaceae), for example, the olive, the lilac, the privet, *Forsythia*, and *Chionanthus* (fringe tree), all have simple leaves. On the other hand, most of the species of the ash and those of the jasmine, also members of this family, bear compound leaves of several segments each. The box elder *(Acer Negundo)* sometimes called the ash-leafed maple, is one of the few maples which bears compound leaves. Both the ash and the box elder, however, begin their lives with simple leaves and it is not until the fifth year that the ash bears the typical adult leaf[3]. It is plain that, in respect to their leaf characters, both the ash and the box elder are more or less odd members of their respective families. In this type of leaf variation the simple blade might be considered primitive, phylogenetically, since in its ontogeny the first leaves of the plant are simple.

Rhamnales

The order Rhamnales (also called Celastrales) includes several families: the buckthorn family (Rhamnaceae), the bittersweet family (Celastraceae), the grape family (Vitaceae), the holly family (Aquifoliaceae), the sandalwood family (Santalaceae), and the mistletoe family (Loranthaceae). The leaves of most of the plants in this order are generally simple and their blades are either entire or only finely serrate or dentate, the chief exception to this being exemplified in the grape family. In the numerous varieties of the grape, *Vitis vinifera*, the simple leaves are generally deeply lobed or toothed. The leaves of *Parthenocissus quinquefolia*, commonly called the Virginia creeper, are definitely palmately compound and are regularly five-parted, as the specific name suggests. In *P. tricuspidata*, commonly called Japanese ivy or Boston ivy, the typical leaf of the adult vine is simple and is deeply trilobed or cuspidate. It is well known that sometimes, generally on the twigs from the older branches of the adult vine, there may be found an occasional palmately-veined leaf of three segments as well as leaf forms which are intermediate between these and the typical grapelike leaf. This variety of forms among the leaves of *P. tricuspidata*, as compared with the more stable type of leaf in its congener *P. quinquefolia*, raised the the question as to whether the occasional compound leaf and the apparently transition forms of *P. tricuspidata* might not be another case similar to the kind of evolution which is suggested in the box elder and the ash as referred to above.

Buckthorn-Grape Alliance

All of the seedlings and the leaves of the adult plants used as illustrations in this study were collected on the campus of Rosary College. Most of the walls of the buildings are overgrown with the so-called Japanese ivy *(Parthenocissus tricuspidata)*, and its congener *P. quinquefolia* grows wild, climbing the trees and fences wherever its tendrils find a support. Several varieties of the grape *(Vitis vinifera)* are common throughout this area and the seedlings are numerous wherever they escape the lawn mower.

Two species of buckthorn *(Rhamnus dahurica)* and *R. Frangula* are well represented among the transplanted shrubbery which adorns the campus. From midsummer until late in the autumn the numerous seedlings of these shrubs almost carpet the ground underneath their branches. In the more remote hideouts may be found second year and older saplings of all these species. In these two species of *Rhamnus*, the seedlings and adult leaves of which are here illustrated, there is slight difference, if any, in leaf form between the primary and subsequent leaves. The cotyledons of *R. dahurica* are quite conspicuous and persistent, functioning as foliage leaves (Fig. 3). The cotyledons of *Rhamnus Frangula*, on the other hand, do not emerge from the seed coat. Hundreds of these seedlings were observed on the campus, but no trace of cotyledons was evident. Finally, a seedling was dug up to which the seed coat still clung (Fig. 1). This showed conclusively, as did seed later sprouted on moist paper, that the cotyledons in this species do not emerge from the seed coat.

These specific representatives of the grape family are difficult to distinguish among the very young seedlings, that is, the cotyledons of the grape and of these two species of *Parthenocissus* so much resemble each other that, before the unfolding of the first leaf bud, one must withhold a positive identification. Moreover, the seedlings and older plants are numerous even in places remote from the parent plants. This condition indicates clearly the agency of birds in the dissemination of their seeds. The primary leaf of the grape, however, is similar to the leaves of the adult plant and identification of this seedling is therefore soon made with certainty (Fig. 2). Hundreds of seedlings of *P. tricuspidata* were examined. Always the first and subsequent leaves—probably all of the first two (or perhaps all of the third) years' leaves—are definitely ternate (Figs. 4-5). Usually the primary leaf of *P. quinquefolia* (commonly called Virginia creeper or woodbine), is quinate (Fig. 10), but, occasionally, the first leaf may bear only three or four leaflets, some of which may be more or less anomalous (Figs. 11-13). In such cases, before deciding the species, one must wait to

(Continued on Page Thirty-two)

[3] *O'Hanlon, Fundamentals of Plant Science*, p. 74 (Crofts, 1941).

Photograph by Robert Turrill Hance

NEW BOOKS

Elementary Meteorology

• *By* V. C. Finch, G. T. Trewartha, M. H. Shearer and Frederick L. Caudle. McGraw-Hill Book Company, Inc., New York, 1942. x + 290 pp. $1.76.

This excellent book offers to the uninitiated a brief, but sound, introduction to the fundamental scientific principles that are necessary to an understanding of the "how" and "why" of weather and climate, and their application to flyers and flying. Although it is designed primarily for secondary school students and for those about to enter the armed forces, the authors present technical information in such a simple and interesting manner that this volume can be read with pleasure and profit by the general reader.

The book is well made and well illustrated. Subject matter is up to the minute. Storms and their weather types are given excellent treatment. The chapters on weather information for pilots and weather applications to aviation show wide personal experience in aerology. Each chapter concludes with a summary, questions on the text, suggested activities for applying the principles given, and a bibliography. A portion of the material of this book is taken from *The Earth and Its Resources*, a textbook of physical geography by Finch, Trewartha and Shearer, which was favorably reviewed in our September, 1941, issue.

One of the co-authors of this book, Professor Caudle, is the writer of the interesting article *The Pilot and Meteorology* in this issue. *W. John Davis*

Mathematics for Pilots
Physics Manual for Pilots

• Training Division, Bureau of Aeronautics, U.S. Navy. McGraw-Hill Book Company, Inc., New York. 1943. Mathematics, ix + 157 pp. $0.75. Physics Manual, ix + 229. $0.90.

These valuable pocket-size books, which are parts of a projected 13-book Flight Preparation Series, are designed to provide an understanding of the fundamentals of mathematics and of those principles of physics that must be mastered by aviators if they are to be safe pilots. The reviewer likes the treatment of mathematics especially well. It was written by an experienced teacher, for it takes nothing for granted. Even such simple operations as the addition, subtraction, multiplication and division of whole numbers and fractions receive attention. The study of percentage, and powers and roots is followed by angular measurement, vectors, equations, variation, and graphs. Many problems are included. Answers to them are provided.

A few problems are to be found in the Physics Manual also, along with the briefest possible discussion of certain pertinent phases of physics. Necessarily, the treatment is elementary since the book is to be used by students who have no previous knowledge of the subject. The book is characterized by a judicious selection of topics presented in an unconventional order, clear writing, an interesting style, and the use of numerous diagrams and line drawings.

Andrew Kozora
Ground Instructor, C.A.A.
Duquesne University.

Air Navigation

Part I: Introduction to Earth. xi + 79 pp. $1.00.

Part II: Introduction to Navigation. ix + 81 pp. $1.00.

Training Division, Bureau of Aeronautics, U.S. Navy. McGraw-Hill Book Company, Inc., New York. 1943.

These books on Navigation have been rushed to completion and streamlined to meet the need for training pilots in the present emergency when pilots must acquire a basic working knowledge of navigation in a minimum of time. While non-essential matter is, therefore, omitted, care has been exercised that enough theory and background material are provided for an intelligent understanding of navigational principles. Like the others of the Flight Preparation Series we have seen, these books are very well done. One is impressed by the simplicity, clarity and conciseness of the material presented.

Part I is designed to orient the student to navigation which may encircle the globe. It employs a minimum of textual matter and numerous clever drawings and maps to depict the geography of Axis strategy and of the United Nations' supply lines. It points out the key objectives of economic importance and those of locational significance, and it summarizes the climate and weather likely to affect flying over oceans and in certain war zones. This book was produced in exactly 19 days after the manuscript was approved.

Part II covers the basic fundamentals of navigation technique. The definitions and descriptions given are unusually good, and some excellent drawings illustrate the explanatory matter. The chapter on maps, charts, and projections is excellent.

The remaining books of the Flight Preparation Series should soon be off the press. If they follow the pattern of these precursors, they're decidedly worth waiting for.

W. John Davis
Asst. Coordinator
C. P. T. Program
Duquesne University.

Organic Chemistry

• *By* G. ALBERT HILL and LOUISE KELLEY. The Blakiston Company, Philadelphia. 1943. 919 pp. $4.00.

This book is designed to be both text and reference book. It will serve admirably in both capacities for the undergraduate student. The first chapter is devoted to a consideration of modern atomic theory and its application to the structure of organic molecules. Throughout the book frequent references are made to this material in considering the possible mechanisms of organic reactions, a practice that should stimulate the serious student.

The book is wide in scope, including not only the traditional material of a beginning organic text, but also several chapters on plastics, synthetic rubbers, new solvent materials, medicinals, vitamins, etc. Specific reactions of commercial and biological importance are discussed fully, but type reactions and preparations are also adequately stressed. The chapters on proteins and carbohydrates are especially well handled. The classification of alkaloids might be improved. The omission of certain other material might be criticized, but the selection of topics is a matter of judgment and no book can contain everything. This one has a wealth of material. Its use as a reference book for the more advanced student is limited, however, by the lack of references to sources. As a text for chemistry majors it should find a high place in the list of worth while organic texts. *W.R.L.*

Science Plays on the Air

• *By* CARL L. SWIFT. Published by the Author, Toaz High School, Huntington Station, Long Island, N. Y. 1941. 66 pp. $0.35.

This unbound mimeographed booklet, published by the author of the article of the same name on page 9, will be extremely useful to anyone interested in preparing actual science broadcasts or even simulated ones to be used as features of school assemblies.

The introductory material includes a statement of the objectives of science broadcasts by students. Then follows a discussion of choice of topic, writing the script, mechanical features of script writing, and choosing and rehearsing the cast. Several 12-minute scripts that have been broadcast over Station WBEN at Buffalo form the main part of the booklet. They deal with buoyancy, sound waves, magnetism, weather, water and similar topics. Some of them include hanging questions for listeners to answer. Purchasers of the booklet are entitled to use the scripts on any non-commercial program *H.C.M.*

Scattering of Light and the Raman Effect

• *By* S. BHAGAANTAM. Chemical Publishing Company, Inc., Brooklyn, N. Y. First American Edition, 1942. 329 pp. $4.75.

This volume, written by a well known investigator in the field of radiation, is a very valuable contribution to the literature on the scattering of light and the Raman effect. It represents a successful attempt to bring together and present in connected fashion the principal information published in various journals in recent years. The experimental work is well described and the theories and important conclusions are clearly set forth. Mathematical developments generally are presented with only very brief explanation, and many relationships are stated without reference to their derivation. Therefore, mathematically the treatise is not for the novice in this field but rather for the worker who already is familiar with the mathematical developments and who wishes to use the book for reference and as a logical summary of otherwise scattered information.

There is the usual table of contents, giving topic headings, but the index is almost entirely an index of names, including only a few references to subjects. The volume is well printed and well bound. *G.E.D.*

Electric Wiring

• *By* ALBERT A. SCHUHLER, Signal Corps, U. S. Army. McGraw-Hill Book Company, Inc., New York. 1943. ix + 400 pp. $2.50.

Any book which has reached a fourth edition has demonstrated its worth. Even a brief examination shows why this textbook of applied electricity for vocational and trade schools has been successful. The general plan, and the selection and presentation of material show that the author is an experienced worker and a skillful teacher. The book is wholly practical and does not deal with theory any more than is absolutely necessary. The several Units study the wiring of bells, annunciators, and burglar alarms, and with electric light, telephone and telegraph wiring. One unit is devoted to testing, and to the location of trouble. *A.K.*

Chemical Technical Dictionary

• *By* A. W. MAYER. Translation under the direction of PROFESSOR B. N. MENSHUTKIN and PROFESSOR M. A. BLOCH. First American Edition. Chemical Publishing Company, Inc., Brooklyn, N. Y. 1942. 872 pp. $8.00.

Practicing chemists, teachers and students will find this dictionary invaluable in their study of the Russian, French, and German chemical literature. It should find a place in every library. Printed in America, it is a translation of A. W. Mayer's German dictionary. It is reasonably comprehensive in scope. Its definitions are very concise. *H.C.M.*

Fundamental Jobs in Electricity

• *By* EDGAR C. PERRY, A. M., Superintendent of Schools, Indiana, Pa., and HARRY V. SCHAFEBOOK, Stetson Junior High School, Philadelphia, Pa. McGraw-Hill Book Company, Inc., New York. 1943. xiv + 447 pp. $2.20.

This textbook, designed for use in shop courses, deals with electrical theory as well as with practical applications. It provides a two-year course that should give students a good understanding of the fundamentals of electricity and the necessary skill to perform a considerable number of practical jobs. It is written and illustrated so clearly that it may almost be used for self-teaching. The book consists of nine Units made up of 121 jobs ranging from the study of the primary cell, through signal wiring, communication, safety, light and power wiring, and generators, motors and transformers. It includes electrical refrigeration, automobile and airplane wiring, and the electric eye. There are several appendices, in one of which is to be found a brief statement telling the student what he should

know at the completion of his course, what he should be able to do, and what desirable attitudes and habits he should possess. Suggestions for instructors are also given. This is a good book. *A.K.*

Earth's Adventures

• *By* CARRELL LANE FENTON. The John Day Company, New York. 1942. 207 pp. $3.00.

This book, to believe its subtitle, is The Story of Geology for Young People. "Of All Ages" might appropriately have been added, for although its author has simplified the processes of geology, he has done it in a style that sets no reader-age barriers. He has abundantly illustrated his descriptions with line drawings, supported by beautifully clear photographs of the real thing. In the very short space of two hundred pages he has presented the essentials of earth lore so that they may be understood by any who will but read. *R.T.H.*

Fire Protection Engineering

• National Fire Protection Association, Boston, Mass. 1943. 196 pp. $2.00.

This little book should be required reading for everyone concerned with the construction and maintenance of public buildings and industrial installations. Every citizen will find valuable information within its appropriately red covers.

The book is a symposium of papers presented by specialists at a Conference on Fire Protection Engineering held at the Massachusetts Institute of Technology in June, 1942, under the joint sponsorship of the Institute and the National Fire Protection Association. The high-sounding title is somewhat misleading, for the papers are written in language easily understood by the layman. Adequate protection from fire in building construction, maintenance of equipment, zoning, water supply, and other pertinent topics are discussed. The problems of fire protection and the education of the public in fire prevention are live topics at any time. They are doubly interesting in wartime. *W.R.L.*

(Continued on Page Thirty-six)

Adventures in Research

(Continued from Page Eight)

For example, in a recent broadcast we took a little tour of a microchemical laboratory where, among other things, minute particles of matter retrieved from defective industrial machinery may be analyzed for a clue to the reason of the machine's failure. We showed the apparatus used and described how the spectroscope, the microscope and the X-ray are put to use in microchemical analysis. By this method we were able to convey a picture of the laboratory at the same time that we touched on several vital principles and applications of science.

Station KDKA in Pittsburgh began carrying *Adventures in Research* more than a year ago. Shortly thereafter several other Westinghouse stations took it up: KYW in Philadelphia, WOWO in Fort Wayne, WBZ in Boston and WBZA in Springfield, Massachusetts. Now many other stations have expressed interest in it, and at the present moment about 70 stations in a large majority of the states have begun broadcasting transcriptions as a weekly educational feature. One of these is in Alaska, broadcasting to our troops in the Aleutians and counteracting the influence of Japanese broadcasts.

The striking success of a program so different in form and content from the usual types of radio entertainment is indicative of the strong desire on the part of young people and adults for material which will help them better to appreciate, and even to take part in, the scientific world in which they live.

Statistical estimates show that more than 150,000 listeners tune in on *Adventures in Research* regularly on only two Westinghouse stations. Apparently it is used by science teachers as material that is useful for their classes, as well as by a great number of people who are just eager to learn about things scientific. In one instance, it offered new hope to the family of a dying woman. A discussion on a program mentioned the use of radioactive phosphorus as a therapeutic agent in the treatment of lukemia. The program was scarcely finished when a man called and wanted to know where he could get some radioactive phosphorus. His sister was dying of lukemia. We told him, and some phosphorus was flown in from California—too late, unfortunately.

On the less serious side was a letter from a man in our audience in Philadelphia. He had been listening to a science quiz program of the sort we occasionally put on to answer questions that come in to us. One of the questions was that old favorite, "What happens when an irresistible force meets an immovable object?" The obvious and correct answer given was that the two terms were mutually exclusive and could not be considered together in the same problem. The listener from Philadelphia, however, wrote in that we were just dodging the issue, that when an irresistible force meets an immovable object we have "inconceivable concussion"!

Events like this signalize some of the unexpected and often gratifying results of the program, but its real effectiveness is something that would be very difficult to calculate. We know that people listen with interest to the program, for if nothing else we have hundreds and hundreds of letters from listeners seeking more information about some phase of a discussion or simply expressing their enthusiasm. But how will we ever know if our discussion of viruses is the spark that starts a career in medicine and ends some twenty years from now in an important discovery in disease control?

In this respect, we are in much the same position as a classroom teacher. We have no way of evaluating the long-time objectives of our work. But we feel confident that in our effort to help make our students and citizens more conscious of scientific affairs we are paving the way towards greater receptiveness to the future advances in science and a richer creativity in tomorrow's laboratory researchers. ●

Nutritive Value

(Continued from Page Seventeen)

parts of starch in 80 parts of a 0.03 N HCl solution, and to heat the mixture for approximately 30 minutes under 40-45 lbs. of steam pressure. The hydrolysis reaction proceeds somewhat as follows:

Starch ⟶ Dextrins ⟶ Maltose ⟶ Dextrose ⟶ Condensation Products.

As the hydrolysis proceeds the percentage of dextrins gradually decreases while the percentage of maltose passes through a maximum as it is hydrolyzed to dextrose. The finished solution contains, roughly, 90% of dextrose, and certain condensation products of the sugar which ultimately find their way into the molasses, or mother liquor. The hydrolyzed solution is refined by a filtration process over bone-black and vegetable charcoal and is then concentrated and subjected to a crystallization operation. This initial crystallization operation produces the alpha dextrose hydrate. To produce dextrose for intravenous use, it is further purified by dissolving it in water, giving it an additional refining with vegetable charcoal, and crystallizing it at substantially higher temperatures and concentrations in order to produce the alpha anhydrous dextrose. The product resulting from the double crystallization is characterized as chemically pure and meets all the requirements of the *U. S. Pharmacopoeia.*

The Physiological Action of Dextrose

Dextrose is the primary substance of carbohydrate metabolism. It is the unit sugar into which all carbohydrate foods must be converted before utilization by the human body. During digestion, sucrose or cane sugar is broken down into dextrose and fructose; the fructose is subsequently also transformed into dextrose. Starch yields dextrose by the same mechanism. Lactose found in milk, maltose in syrups, and all other carbohydrates undergo a similar transformation. In every case, dextrose is the ultimate product of carbohydrate digestion. Dextrose itself is therefore rapidly absorbed from the alimentary tract, requiring no digestion. The absorption of dextrose takes place mainly in the small intestine, to a lesser degree in the stomach, and only in extremely small quantities in the colon.

The rate of absorption of dextrose is always constant although the factors involved are complex. The same rate is maintained regardless of the quantities or concentrations of the ingested dextrose solutions. Cori and Cori (1934) have demonstrated that the average rate of absorption of dextrose in the human body is 0.8-0.85 g. per kilo. body weight per hour. If the amount of dextrose ingested exceeds this, absorption will not take place at a faster rate; it will simply continue for a longer time. By so regulating the amount of dextrose which enters the blood stream, the process of absorption aids in keeping the blood sugar of normal persons from attaining extremely high levels.

Following absorption, dextrose is transported by the portal vein to the liver where some of it is synthesized into glycogen, and some carried by the blood stream to the tissues where it is oxidized. Glycogen, the only form of animal carbohydrate, is manufactured and stored mainly in the liver and to a slight extent in the skeletal and cardiac muscles (Loeper). The conversion of dextrose into glycogen by the liver is known as glycogenesis. The reaction is reversible. When absorption of dextrose has ceased, or when the demand for dextrose is greater than the supply, liver glycogen is reconverted into dextrose. It then passes from the liver cells back into the blood stream, the mechanism being referred to as glycolysis. These two processes maintain a normal blood sugar level, which varies in man from 0.08% to 0.12% under physiological conditions.

When normal body physiology (nutrient absorption, liver function, or tissue oxidation) is disturbed, there is a simultaneous derangement in the regulation of the blood sugar level. If the value falls below 0.08%, a state of hypoglycemia is present; conversely, a value over 0.12% exists in hyperglycemia. When, during hyperglycemia, the blood sugar rises above 0.15-0.17% (renal threshold), excess dextrose is spilled in the urine. Hence the clinical picture of glycosuria on surpassing the renal threshold.

Glycosuria may also be an indication of lowered renal threshold. It may often result from the inability of the body to keep the blood sugar within normal limits. Woodyatt, Sansum and Wilder (1915) have estimated experimentally, the rate of utilization of dextrose by the normal body to be 0.8-0.9 g. per kilo. body weight per hour. By injecting a dextrose solution intravenously at this rate, glycosuria is not produced. The capacity of an individual to tolerate dextrose without glycosuria can be measured and is known as the *dextrose tolerance test.* One hundred g. dextrose are given, the blood sugar level is determined and the urine is tested for dextrose at half-hour, 1 hour, and 2 hour intervals. These tests are valuable in determining disturbances of carbohydrate metabolism. However, 100 g. is by no means the maximum quantity of sugar tolerated. Dodds (1925) has found that no urinary spillage of dextrose takes place even after the ingestion of as much as 500 g. dextrose at a time. This makes dextrose the best tolerated sugar.

Several minor sources of dextrose exist, although the dextrose supply of the body is obtained mainly from the digestion of carbohydrate foods. About 10% of the fat foods ingested are in the form of glycerol and are oxidized to glyceric aldehyde, and subsequently converted to dextrose. Up to 58% of the protein foods are also broken down into dextrose through intermediary reactions. Dextrose is also synthesized from lactic acid in small quantities by the liver and the heart musculature.

Dextrose is essential for normal body metabolism. The absorbed dextrose is carried by the blood stream to the various tissues where it is oxidized. This oxi-

dation is an exothermic reaction in which large quantities of heat energy are liberated. Because of this, and because the normal body burns dextrose in preference to proteins and fats, dextrose is the main source of the body's energy. "Dextrose is the fuel with which life's engine runs."

The oxidation of dextrose involves normal protein and fat metabolism to a certain extent. It is only with the simultaneous combustion of dextrose that both proteins and fats may be completely burned, and their end products normally excreted. Without the oxidation of dextrose, amino acids formed from proteins are converted into and excreted as aldehyde or ketone bodies. For the same reason, fats form ketone bodies (acetone, diacetic acid, and β-oxybutyric acid). The subsequent accumulation of these ketone bodies marks the beginning of ketosis; the excretion of ketone bodies in the urine naturally follows ketosis and is known as ketonuria. This disorder therefore results from either a deficient supply of dextrose in the body, or from an impaired ability of the tissues to oxidize dextrose.

The assimilation of dextrose by the body and glycogen synthesis depend upon a hormone, insulin. Insulin is manufactured by the cells of the islands of Langerhans in the pancreas. The islet cells are sensitive to the blood sugar levels in the normal body. Thus, the administration of dextrose, causing a rise in blood sugar, stimulates the activity of these cells, resulting in an increased production of insulin. The insulin in turn mobilizes the dextrose by a special mechanism, promptly removing all excess sugar from the blood. That is why the administration of large quantities of dextrose does not produce a prolonged state of hyperglycemia or glycosuria in normal persons.

It is obvious then that overproduction or overactivation of insulin is instrumental in causing hypoglycemia despite a normal carbohydrate supply. Likewise, underproduction or inactivation of insulin prevents the assimilation of dextrose and leads to hyperglycemia and glycosuria. Both hypo- and hyper-glycemia are manifestations of metabolic disturbances; the former is related to shock and convulsions, the latter, to diabetes.

The physiological action of dextrose in health, its vital role in metabolism, therefore renders it indispensable for life. The physiological action of dextrose in disease, its ability to rectify faulty metabolism and related functional disturbances renders it indispensable for life. And the physiological action of dextrose in disease, its ability to rectify faulty metabolism and related functional disturbances renders it a very valuable therapeutic agent. The specific effect of dextrose in pathological physiology must be considered in detail for each disease. ●

Science Plays

(Continued from Page Ten)

and membership cards were distributed during the same period. Many boys and girls wrote long, newsy, personal letters. When boys and girls come many miles (in one case over 60) to put on a program, it is evident there is much interest.

Teachers found keen interest in the programs among their classes. They also reported different methods of using the broadcasts. In many cases, the program was discussed in science classes on Monday morning. Teachers used the scripts for their own class programs or assembly programs. Some classes sent representatives to the studio who reported back to the class the details of the broadcast and the forum.

A questionnaire revealed that many pupils listened in, even though the broadcasts were not utilized in the classrooms. It was plain that there were a great many enthusiastic listeners. The value of the broadcasts did not lie entirely in the science material presented. The youngsters were entertained, they learned subtly, they experimented in their homes, and they developed interest in discovering things for themselves.

Although objective and statistical data are incomplete, surveys indicated that both teachers and pupils found the programs of value and interest.

Use of Scripts

The best way to employ the scripts is actually to make arrangements for using them over the local broadcasting station. The difficult task of writing and revising the material is finished. If a group of teachers will rehearse a play and present the material to the station director he is likely to become interested at once. The series was "sold" to a station manager four years ago when a script was prepared and the experiments performed right on his desk. For greater help teachers are referred to the 70-page mimeographed booklet containing eleven scripts and valuable production hints, which can be purchased from the writer for thirty-five cents postpaid. Science teachers in the New York City area will be aided personally by the author if they so desire.

The scripts may be used as an assembly program. Many teachers have reported successful programs when the plays are presented with the stage simulating a studio with control booth, lights, sound effects, etc. Scripts can also be used in the classroom as an important addition to the science lesson.

☆ ☆ ☆

This article has attempted to show how a new type of educational radio program can be made interesting to youngsters. It is important to keep in mind that the value of science depends not only on the scientific facts themselves, but also on the concomitant and attendant values, which are sometimes less obvious.

Since one of the goals of science teaching is to understand and appreciate our surroundings, it is plain that there are many other ways to achieve that goal besides using textbooks. Other means can be valuable.

Regardless of the means we employ to reach our ends, it is our job to make science more vital, more meaningful, and more common. If we inculcate in a youngster the idea of wonderment, of respect for the unerring laws of science, can we not expect a carry-over of such virtues into his daily life? Does a person destroy that which he appreciates and understands? If a boy feeds birds and is kind to them, will he shoot them? Can we expect that a closer understanding of nature's laws will perhaps mean a closer and better understanding of man's laws? When a child realizes and notes the orderliness of nature, can we expect some reflection of those ideas in maintaining his own personal life?

Perhaps we can learn a great deal ourselves if we follow Wordsworth's maxim, "Let Nature be your teacher." ●

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Please read the article on page 2 carefully.

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From Stars to Atoms

(Continued from Page Sixteen)

High School Students Inspecting the Projection Planetarium.

parochial schools in the Diocese of Pittsburgh which have participated in the Junior Science Fairs of the past three years. Among them were:

Holy Rosary High School
Sacred Heart High School
North Catholic Boys High School
Mt. Nazareth Academy
St. James High School
St. Mary of the Mount High School
St. Rosalia High School
St. Wendelin High School
Ursuline Academy
Mt. Gallitzin High School
St. Joseph Academy
Vincentian High School
St. James High School
St. Raphael High School
St. Luke High School
St. Basil High School
Central Catholic High School

In connection with last year's Junior Science Fair, the Planetarium conducted a Saturday afternoon quiz program which was broadcast by KDKA. At each of these quiz sessions four or five or six science students, each selected as the outstanding science student of his or her high school, were brought to the KDKA microphone where they were asked science questions submitted by outstanding men and women of science of the Pittsburgh region. At the conclusion of the first four programs, a special program was broadcast on which the champions of each of the four previous programs competed. Three of the boys who appeared on that program were offered scholarships by Carnegie Institute of Technology. One of these scholarship winners was James Kennedy, a senior of St. Mary of the Mount High School. The Planetarium was pleased of course, to have this recognition of its work among high school students recognized by Carnegie Tech.

And so it is that we on the staff feel that while the Fair is only one of many activities directed toward the boy and girl, it is by no means a minor one. We feel it is a good example of the proper methods to be used in guiding these youthful science enthusiasts toward their goal. Thus we look back on past Fairs with real satisfaction, and ahead to future Fairs with the hope that we can offer even greater stimulation to the boys and girls who are destined to be our scientific leaders in the post-war world. We regard the Fair as reflecting the function of such an institution as ours, which is to make science truly a part of people's lives, to make science work increasingly for the greatest happiness of all—both the adults of today and those who will be the adults of tomorrow. ●

The Camera Club

(Continued from Page Twelve)

material from city newspapers, school newspaper or school administration offices may be complied with promptly.

All these activities of the club are coordinated with the weekly club program which will consist of, as you readily can see:

1. Discussions arising from questions which are asked concerning the pictures that were obtained over the weekly period.
2. Ways and means whereby this service can be be made more efficient.
3. How better and more interesting pictures may be obtained.
4. The personal advancement of club members must also be formulated and discussed so that the members may continue to advance in proficiency and knowledge of the photographic art.

New developers and methods of handling films and prints also are reviewed in these meetings to keep members posted on the newer techniques and to encourage creative endeavor by club members.

In conclusion, a word about the advisor and his work. From this paper it will be seen that this assignment is no one-hour-a-week-recess, for work is going on continuously each, or almost each, hour of every school day. Under all circumstances the sponsor must be cool and cooperative even though some of the assignments that are required are well nigh impossible of accomplishment. Above all, he must be a camera fan and photographic addict with a keen insight into the problems of amateurs and an understanding of the ways and means for accomplishing almost any kind of an assignment. Not a news photographer, he receives requests for the coverage of almost as widely varied topics. He must be ever on the alert to promote the well being of his club by improvement in the jobs assigned.

This pays big dividends, since newspapers employ this trained personnel without question and even without further training. The Army and the Air Corps find these people proficient, and they rise rapidly from the ranks. Commercial photographers are eager for them as workers in their finishing rooms, and those who do not engage directly in commerce have a hobby which is a joy and a satisfaction as long as they engage in it. ●

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Please read the article on page 2 carefully.

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Aviation Education

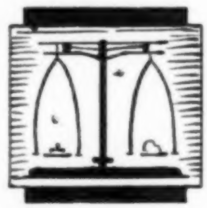
(Continued from Page Six)

The District of Columbia course, provided for by law, has two major aims, one to meet the emergency and the other to provide for aviation instruction on a long time basis. Among the general aims are the following: To develop an interest in aviation among high school students; to provide a foundation for occupational selection in aviation; to provide a basis for training for pilots, aviation mechanics, aeronautical research staffs, aeronautical engineers, military air personnel, and for employment in other aviation occupations; to provide information on aviation services for intelligent air transportation consumers; and to present motivation for other subjects essential for a well-rounded education.

The emergency aims are somewhat different and are as follows: to stimulate interest in military aircraft and to build up personnel for aircraft spotting; to point out to students the importance of aviation in world affairs; to offer Air Services information to high school students contemplating entrance in the Air Services; and to provide a background of information for future aviation personnel in commercial and military aviation.

Guggenheim Contribution to Aviation Education

After this war is over there will be additional need of all types of aviation content in elementary school courses. It will be more obvious then than it has been up to the recent past. Mr. Harry Guggenheim told me late in 1935, when I was making the study on which *Aviation in the Public Schools* was based, that very few thought, in 1926, that the Daniel Guggenheim Fund for the Promotion of Aeronautics, $2,500,000, was a sound venture; and yet the Daniel Guggenheim Fund Committee on Elementary and Secondary Aeronautical Education found that in 1928 over 223 superintendents of schools, supervisors, directors, principals and teachers said they had aviation subject matter in their schools. Today we are reaping the results of a great deal of the aviation education work of the Guggenheim Committee. We seem to be approximating the all-out-for-aviation to win the war. ●



The Pilot and Meteorology

(Continued from Page Seven)

there is one of the world's greatest air schools. The equipment being examined is that which is used to determine weather conditions at high elevations.

Both the Army and Navy are now training large numbers of their men, and the personnel of the WAACS and WAVES also, for duty in weather observing and forecasting. Many more persons will be needed in this interesting work than heretofore. This applies not only to present war activities but to peace as well.

A knowledge of the climate of all parts of the world is now more than ever interesting because our armed forces are stationed in every climate from the tropics to the polar regions. In peacetime we will continue to have representatives in all climates.

For pleasant flying a pilot operates at the elevations above the earth's surface where turbulence, formerly know as air pockets, is at a minimum. Flights at night, in the early morning or late afternoon, and those over water or snow areas are more likely to be smoother than those made during the late morning and early afternoon hours on sunny days over land areas.

Rough air is caused by thermal currents which come from the uneven heating of the earth's surface. Rising currents are found over roads, buildings and plowed fields. Descending currents are prevalent over water areas, pastures and forests. A plane, on encountering an upward thermal current, will appear to bump upward, while a descending current will be associated with a feeling of dropping. Persons taking their first few rides should plan to go on days free from undesirable conditions. A sky overcast with a moderately low cloud stratus or blanket-type cloud layer, indicates smooth flying. This is because the sun does not have the opportunity to cause an unequal heating of different areas on the surface of the earth.

As it flows horizontally over the rough surface of the earth, air causes bumpy conditions due to its friction with hills, trees, buildings and other uneven features. Such bumpiness may be felt up to elevations of about 2,000 feet. In certain types of squall storms, the air is likely to be rough up to 6,000 feet. Rough air is not dangerous when the plane is flown at the proper speed, but smooth air is far more pleasant. Thunderstorms cause extremely rough conditions.

Commercial air lines make every effort to fly planes at elevations which offer smooth riding. Passenger comfort is considered too important to sacrifice, even to fly at elevations where time could be saved. Other things being equal, pilots seek elevations where tail winds prevail. This enables a trip to be completed in less time than would be the case if an altitude were selected where head winds would be encountered. There is not only a saving in time but also in gasoline and in the other expenses incurred in flying on a long trip when a shorter time could have been used. Pilots study weather conditions in the areas in which flights are being made in order to select the most favorable routes for the journey, and also to prevent the undertaking of trips which cannot be completed because of adverse conditions. When a plane has to turn back or to land because of bad weather conditions, it means that the trip might better have been planned for some other time or area.

In taking off and landing the pilot heads into the wind, that is, toward the direction from which the wind is blowing. This enables quicker take-offs and landings, and permits the use of shorter portions of the runway.

The effect of wind direction and velocity on flight levels has already been noted. Two other important elements are ceiling and visibility. By ceiling is meant the distance between the ground and the low layers of cloud covering much of the sky dome. Visibility refers to the greatest distance that can be seen horizontally by pilots landing and taking off. Good visibilities are needed for take-off and landing. If a pilot is to keep track of his position and direction of flight by noting ground objects, it is necessary that he have good ceiling and good visibility. If these are unsatisfactory, he must be qualified, equipped, and authorized to proceed by means of instruments and radio. In poor weather conditions, a flight must be discontinued if the plane is not properly equipped. The pilot must

also know the effect of the weather on his instruments and his plane.

For safety, other conditions must be watched, such as fog, the formation of ice on the plane, thunderstorms, and strong surface winds.

In order to understand and apply weather conditions, all pilots must study meteorology. The Government requires that both military and civil pilots pass examinations in the subject. Commercial pilots keep up with the subject at all times, and occasionally attend meetings and short courses conducted by their company meteorologists. Before flights, pilots visit the weather office, talk to the weather man and study the latest weather maps, charts and forecasts. Hourly weather reports are available for many points along any intended route. In other words, the pilot is able to get a wealth of knowledge and up-to-the-minute information on present weather conditions and forecasts before beginning a trip. After he starts out he can receive additional reports by radio. He watches cloud formations, temperatures, and the wind at the surface in order to be aware of prevailing conditions and alert to possible changes.

Weather conditions have always been and will always be important factors in planning and executing flights. All are familiar with the prominent mention of weather in the pioneer transcontinental and transoceanic flights of not so long ago. Today, frequent mention is made of weather conditions in both civil and military flights. Captain Eddie Rickenbacker in his account of his famous flight in the Pacific, stated that because weather stations were lacking in the area wind velocity had to be estimated. The estimate was wrong and it took his plane considerably off course. Aerologists, as the Navy styles its meteorologists, are always carefully consulted in connection with all naval tactics. Every airplane carrier, known as a flat top, has a staff of well-trained aerologists and aerographers who watch weather conditions night and day. Every pilot is trained in aerology.

While pilots are usually not expert technical forecasters, many acquire the ability to note the approach of storms and other changed conditions. This they do by noting changing barometric conditions, changing wind direction, and cloud types. Forecasting is a fascinating game with most airmen. ●

Leaf Form

(Continued from Page Twenty-one)

see the second leaf which is almost sure to bear five leaflets. Even the primary leaves of probably the majority of the seedlings of *P. quinquefolia* are quinate, and are therefore the typically adult leaves of this plant.

In examining thousands of leaves of *P. tricuspidata* which make up the extensive mosaics on the walls of large buildings, one finds that the great majority of these are simple leaves of the grape type. In searching among the younger twigs which are outgrowths of older and well established branches, one is occasionally rewarded by finding the four main types of leaves which characterize this vine, even on a single twig. These include the simple grape-leaf type which is representative of the majority of the adult leaves, the definitely trifoliate leaf, and the two teratological leaf forms, more or less mirror images of each other (Figs. 7-8). According to its ontogeny, the compound leaf of this vine is the more primitive and it, together with the two transition forms, may all be considered atavistic. On the other hand, such slight variations as we find in the first leaves of the seedlings of *P. quinquefolia*, the reverse order of evolutionary change seems to prevail; at any rate, in their present stage of evolution, the leaf development of these two species seems to indicate diverse goals. In the grape species, according to paleobotanical accounts, there seems to be stability in leaf form.

It is apparently necessary that any preconceived ideas of simplicity and complexity concerning leaf form must be interpreted. Compound leaves, that is, leaves with segmented blades, are certainly complex as indi-

vidual organs and unsegmented leaf blades are generally considered simple by comparison. The amount of foliage in the *total aggregate* of leaf segments or pinnae on a plant which bears compound leaves probably does not exceed proportionately that of a plant which bears simple leaf blades. Consequently, with respect to foliage in general, the question may arise—which type of plant is really more highly evolved, the one bearing relatively few very complex leaves, or the one which bears very numerous simple leaves.

Some plant evolutionists maintain that the reduction of the number and complexity of floral leaves conforms to the idea of progressive change; on the other hand, they argue that plants, for example, the magnolias which have retained their numerous floral organs (all leaf homologues) throughout long periods of evolutionary change, are therefore primitive. If elimination and simplification are considered advances in the evolution of floral leaves, why may not simplification, at least, be so interpreted with respect to foliage leaves. In its ontogeny, the leaves of the Japanese ivy *(Parthenocissus tricuspidata)* suggest just such a theory, a theory which is immediately exploded, however, when we consider the ontogeny of such plants as the box elder, the ash, or a number of representatives of other plant families in which the evolution of foliage leaf form seems to proceed contrariwise to the evolution of their floral leaves.

The tree ferns, probably most of the ferns, as well as the cycads, bear foliage leaves and sporophylls which are not greatly different from those of their more primitive ancestors. According to fossil records, angiosperms, such as the magnolias and the tulip tree, have retained both their foliage and floral leaves in their more or less pristine forms. On the other hand, according to acceptable evolutionary theories, our modern box elders and some of the ashes, *Fraxinus excelsior*, for example, have arrived at their present distribution and structure of floral organs by a progressive elimination and simplification. Apparently, some of them have thus reached the evolutionary peak in reproductive structures; this is expressed in dioecious plants bearing very simple flowers, some of which are apetalous and wind-pollinated. On the contrary, according to their ontogeny, the foliage leaves of these plants, as individual organs, at least, have increased in complexity. The box elder, representing the maples, exemplifies what may be considered progressive elimination of sterile floral leaves, since most of the other *Acer* species bear choripetalous, polygamous, or perfect flowers, and simple foliage leaves. At the same time, the box elder seems to suggest progress in the opposite direction where foliage leaves are concerned.

The lilac, as an example of the olive family, bears complete flowers but simple foliage leaves; whereas in the same family, the ash, at least most of its species,

is dioecious, bearing apetalous flowers and (in the adult) compound leaves of several segments each.

Thus, some of the questions which arise are both perplexing and intriguing—like the many other problems which make the whole evolutionary process a conundrum which seems to defy a satisfactory explanation. Certain significant facts apply to the evolution of leaf form in specific plants; these cannot, however, be reconciled with any single line of evolutionary progress or change. Even the results obtained from the study of the plants here discussed point to the conclusion that there is no exclusive or definite rule for the evolution of leaf form, even within a generic relationship. Subsequent papers will include data derived from a study of juvenile leaves of other plants quite unrelated to those here considered but which, nevertheless, contribute additional support to this tentative conclusion. ●

Graduate Students

(Continued from Page Fourteen)

tions, which have tended to their urbanization. The tendency for more and more Catholic young men and women to attend the tax-supported agricultural colleges is indeed a hopeful sign and only a step removed from majoring in some branch of agricultural science and assuming a responsible role in its development.

An illuminating analysis, by E. J. Ross, of the position of the Catholic Church in relation to agriculture in the United States, appeared in the October, 1942, issue of *Columbia* magazine. The points stressed in this article deserve repetition.

(1) A minority of about 25 per cent of American Catholics live in rural districts.

(2) With few exceptions the Church has centered attention on the 75 per cent of urban members.

(3) Unless the rural minority of the population is increased, there will be a progressive decline in the total Catholic population, because city populations are not reproducing themselves.

(4) The ideal of rather materialistic city capitalism or living for rural peoples has failed to provide for their needs and is leading to the decline in power of the Church in country districts.

According to Ross, the rural priest of courage and vision can remedy the situation. Specially organized schools for rural priests are needed to correct the deficiencies in seminary training and in current knowledge. He points out that one cannot keep people happy on farms for materialistic reasons. Rather, they must stay there because they become convinced of the sacredness of the soil, of their greater opportunity for developing a spiritual viewpoint than those in most other callings. The truly Christian view of life is not one of material gain, but of right living.

The multiplication of rural schools for priests, now under the sponsorship of the National Catholic Rural Life Conference, will lead not only to increased competence on the part of the rural pastor in matters of counsel and guidance to young rural people, but also to a greater understanding of the aid the rural pastor himself may need.

The matter of vocational guidance mentioned in the opening paragraph and stressed by Monsignor L. G. Ligutti, Secretary of the N.C.R.L.C., on many occasions, undoubtedly deserves first place in emphasis on curative measures. More competence in counseling young people, all will agree, is of fundamental importance. That something ought to be done to correct the present abnormal representation to the point of proportional representation in the agricultural institutions of this country, is likewise much to be desired. That the principles and disciplined ideals of the Catholic way of life, in common with the ideals of other religions, deserves a truly representative place alongside those of atheism, agnosticism, and non-belief, in the tax supported schools of the country, likewise cannot be opposed on sound grounds. This thesis is all the more important in the present turmoil-ridden world where the forces of evil must be met and defeated by Christian principles, if civilization itself is to survive.

In conclusion, it should be stated that the present rather insignificant role played by Catholics in agricultural science is of their own making and not to be attributed to others. The free American institutions of learning are open to all and so far as the writer is able to judge, encouragement is rarely denied to the talented. ●

To the Catholic Schools

(Continued from Page Two)

penditures carefully during the period of the war. Costs of publication are rising. But the University is unwilling to sacrifice quality, preferring to cease publication rather than to cheapen the journal in content or makeup, a decision which we are confident you will approve. The receipt of a minimum of 500 new subscriptions at $1.00 each will permit us to continue. You can help.

The special subscription order form, printed on this page, may be used. Or a letter will do. Send in several subscriptions if you can. Should the necessary number of subscriptions not be obtained, all remittances will be returned. So will the unexpired portion of the older subscriptions now in force. We hope such refunds will not be necessary.

This is our last appeal.

The decision lies with you.

Whatever it may be, please make it quickly.

THE EDITOR.

New Books

(Continued from Page Twenty-four)

Laboratory Directions in Biochemistry

• *By* VICTOR C. MYERS, Western Reserve University. The C. V. Mosby Company, St. Louis. Mo. 1942. 288 pp. $3.50.

This really excellent, lithoprinted manual differs from others of its kind in that greater emphasis is placed on clinical biochemistry. This is to be expected since it is designed for medical and dental students. It may well be used by students of pharmacy, home economics and other groups. Experiments are grouped under three heads: biochemistry; clinical biochemistry; and dental biochemistry. There are a number of helpful illustrations and a valuable Appendix. The variety of experiments offered permits the instructor to select those which fit the needs of the particular group he is teaching. More are provided than will usually be performed in a one-semester course. A modern loose-leaf plastic binding permits the easy insertion and removal of pages. *C.H.B.*

Fundamentals of Machines

• *By* JOHN A. CLARK, FREDERICK R. GORTON, FRANCIS W. SEARS and MAJOR FRANCIS C. CROTTY. Houghton Mifflin Company, Boston, Mass. 1943. xi + 300 pp. $1.24.

This book, which was prepared at the request of the War Department and the U. S. Office of Education, is expected to give those who study it a knowledge of mechanics that will enable them to operate machines safely and effectively. It should do so. It is based on the official outline for pre-induction courses in machines. It should help considerably in the war effort—its primary aim—by providing better trained workmen who may later become specialists in the Army air and ground forces or in the services of supply.

Written in simple language, set in attractive type faces, and illustrated with many half-tones and drawings, it is an example of good modern book writing and book making. *A.K.*

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